KUMPULAN MAKLAH

SEMINAR INTERNASIONAL

PENDIDIKAN KIMIA FKIP UNIVERSITAS MULAWARMAN 2015

TEMA:

INOVASI KIMIA DAN PENDIDIKAN KIMIA DALAM MENDUKNG GREEN CHEMISTRY MENUJU KALTIM BANGKIT – 2018

Penyelenggara:

PEOGRAM STUDI PENDIDIKAN KIMIA

JURUSAN PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM

FAKULTAS KEGURUAN DAN ILMU PENDIDKAN

UNIVERSITAS MULAWARMAN SAMARINDA

Aula Rektorat Lantai 4

Jl. Kuaro Kmapus Gunung Kelua Samarinda 75123

Telp: 081347105831 / 082156669908

E-Mail : ischemistryand_e@yahoo.com

PROSIDING

SEMINAR INTERNASIONAL PENDIDIKAN KIMIA

INOVASI KIMIA DAN PENDIDIKAN KIMIA DALAM MENDUKNG GREEN CHEMISTRY MENUJU KALTIM BANGKIT – 2018

Dilaksanakan tanggal 12 september 2015

Di Aula Rektorat Lantai 4 FKIP UNIVERSITAS MULAWARMAN

Samarinda

PROGRAM STUDI PENDIDIKAN KIMIA

JURUSAN PENDIDIKAN MIPA

FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN

UNIVERSITAS MULAWARMAN

SAMARINDA

2015

Prosiding

Seminar Internasional Kimia 2015

"Inovasi Kimia dan Pendidikan Kimia dalam Mendukung Green Chemistry Menuju Kaltim Bangkit-2018"

Editor : Prof. Dr. H. M. Amir Masruhim, M.Kes
Abdul Majid, S.S.i, M.Si
Dr. Usman, S.Si, M.Si
Dr.H. Mukhamad Nurhadi, M.Si
Dr. Erwin, M. Si
Dr. Nurlaili, M.P

Desain Cover & Setting Lay Out :

Andri Wardana

Diterbitkan oleh :

Program Studi Kimia FKIP UNMUL
Universitas Mulawarman
Jl. Muara Pahu Kampus Gunung Kelua, Samarinda
Samarinda – Kalimantan Timur

Susunan Panitia Seminar Internasional 2015

Pelindung	: Prof. Dr.H. Masjaya, M.Si (Rektorat Universitas Mulawarman)
Penasehat	: 1. Drs. H. Syahril Bardin, M.Si (Dekan FKIP UNMUL) 2. Dr. Moh. Bazar, M.Si (Pembantu Dekan II)
Penanggung Jawab	: Abdul Majid, S.S.i, M.Si (Ketua Prodi Pendidikan Kimia)
Ketua Panitia	: Dr. H. Usman, S.Si.,M.si
Wakil 1	: 1. Prof. Dr. H. M. Amir Masruhim, M.Kes 2. Dr.H. Mukhamad Nurhadi, M.Si
Sekertaris	: Nurul Kasyafita, S.Pda., M.Pd. M.Sc
Bendahara 1	: 1. Dra. Maasje Catherine Watulingas 2. Maradona S.Pd
Sidang acara	: 1. Iis Intan Widiyowati, S.Pd.,M.Pd (Koordinator) 2. Dody Setiawan 3. Widya Ismajayanti 4. Aulia Nauli Efendi 5. Maria Elina 6. Rinda Anggita Putri
Konsumsi	: 1. Dr. Nurlaili, M.P (koordinator) 2. Dwi Yuliatika 3. Fermiawati 4. Luthfiyatul Halimah 5. Dea Nur Oktaviany 6. Anis Kurniawati
Pubdekdok	: 1. Dra. Hj. Hartati (Koordinator) 2. Riska Indriani 3. Farlina Eka Waty 4. Sela Defi Alib P 5. Niluh Bara Nonik 6. Agus Harisandy
Kesekretariatan	: 1. Ratna Kusumawardani, S.Si.,M.Pd (Koordinator) 2. Inggar Pratiwi 3. Ina Ruviyana

	4. Noor Rahma Yanti 5. Yaumil Hidayah
Humas dan dana	: 1. Drs. H. Abdul Aziz, M.Si (Koordinator) 2. Wirhanuddin, S.Pd 3. Firman Pradipta 4. Nur Annisa 5. Annisa Rahma 6. Nor Hikmah 7. Radika H.
Perlengkapan	: 1. Muflihah, S.Pd.,M.Si (Koordinator) 2. Yadi Atim 3. Aryo Eko Nugroho 4. Setiawan Budiarto 5. Rizky Alfiansyah 6. Rizal Hariyadi
Pembantu umum	: 1. HMPK (Himpunan Mahasiswa Pendidikan Kimia) 2. Staf Rektorat 3. Muhammad Ikhsan, S.pd 4. Andri Wardana 5. Sopir

KATA PENGANTAR

Pembaharuan sistem pendidikan nasional yang dilakukan perlu disesuaikan dengan pelaksanaan otonomi daerah dan Undang- undang RI. No. 25 tahun 1999 tentang Perimbangan Keuangan antara Pemerintah Pusat dan Daerah.

Demikin halnya dengan pemberdayaan pendidikan kimia dan bidang-bidang lain yang terkait mempunyai peran strategis dalam menyiapkan sumber daya manusia yang handal dan siap menghandapi permasalahan yang muncul ditengah-tengah masyarakat. Penemuan keatif-inovatif bidang kimia dapat dimanfaatkan secara optimal bila pendidik, praktisi, ilmuwan khususnya kimia dan bidang lain yang terkait sangat diperlukan guna menggali dan memberdayakan potensi yang ada untuk disumbangkan pada pembangunan nasional.

Seminar ini bertujuan : (1) Merumuskan kajian-kajian terbaru peranan ilmu kimia dalam pengelolaan sumber daya alam baik yang dapat diperbaharui (non renewable resource); (2) memberikan wadah bagi ilmuwan khususnya di bidang kimia dalam mensosialisasikan hasil-hasil penelitian baik teoritikmaupun ilmu rekayasa; (3) meningkatkan kesadaran akan peranan dalam mendukung terwujudnya penguasaan teknologi yang semakin berkembang; (4) meningkatkan jalinan kerjasama antar kimiawan se Indonesia dalam pendidikan, penelitian, dan pengabdian pada masyarakat; dan (5) meningkatnya terjadinya pertukaran informasi antar peneliti, baik di lingkungan Perguruan Tinggi, Instasi Pemerintah, maupun dari kalangan industrydalam menyiakan sumber daya mausia untuk penguasaan teknologi yang mendukung tercapainya kesejahteraan masyarakat Indonesia.

Pelaksanaan seminar Nasional Kimia merupakan kegiatan rutin setiap tahunnya yang dilakukan secara bergiliran disetiap perguruan tinggi Kawasan Timur Indonesia yang terhimpun dalam Forum Kerjasama Kimia Timur Indonesia (FKK-KTI).

Prosiding ini memuat yang meliputi bidang kajian:Pendidikan kimia , kimia organik, kimia fisika, kimia bahan alam, kimia analitik, biokimia, pendidikan biologi, biologi. Makalah tersebut berasal dari institusi, yaitu, Universitas Mulawarman, Universitas Hasanuddin, Universitas Lambung Mangkurat, Universitas Kediri, Politeknik Ati Makasar, Universitas Malang, Universitas Islam Makasar, Universitas Negeri Surabaya, Dinas Pendidikan Kota Samarinda, SMA Samarinda.

Semoga seminar dan prosiding ini dapat dipergunakan dan diambil manfaat serta mencapai sasaran yang optimal. Saran perbaikan serta kritikan membangun akan selalu diterima dengan ketuluan hati untuk perbaikan.

Samarinda, 12 September 2015

Ketua Panitia,

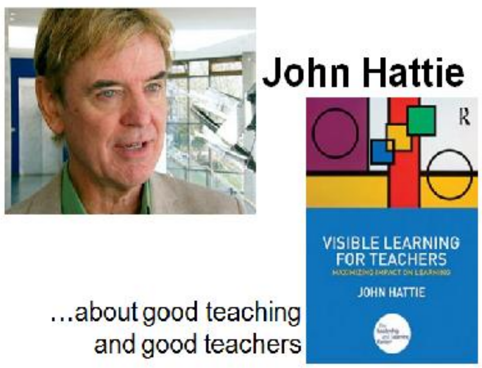
Dr. Usman, M. Si.

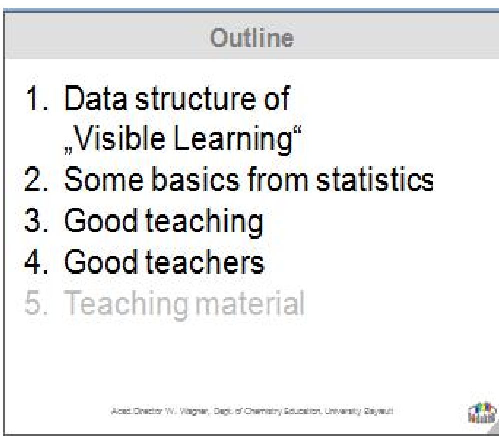
DAFTAR ISI

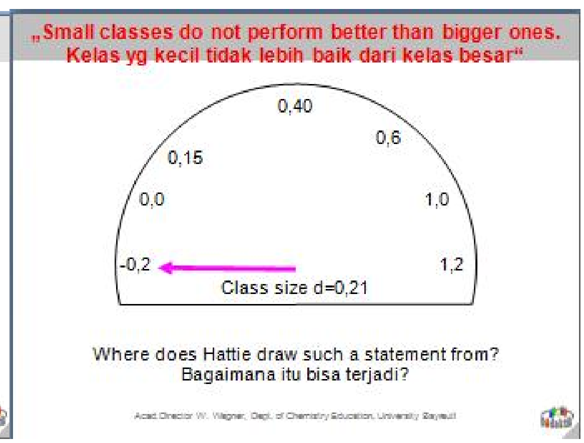
Walter Wagner

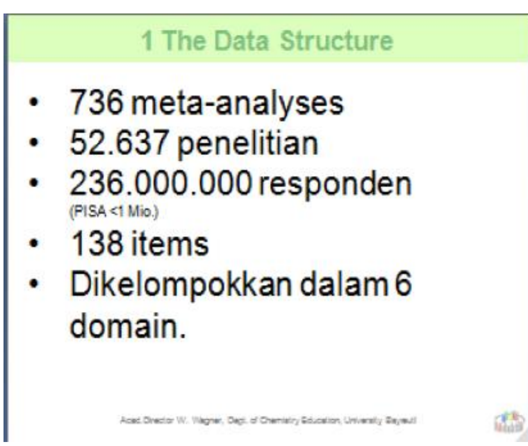
Pembicara Utama

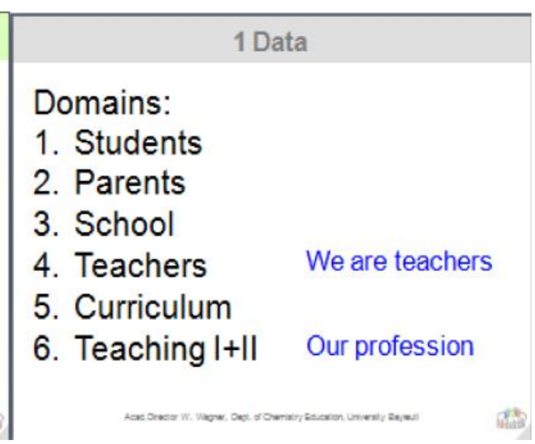
PAPARAN PRESENTASI











Note of the german translators
Catatan dari penterjemah Jerman

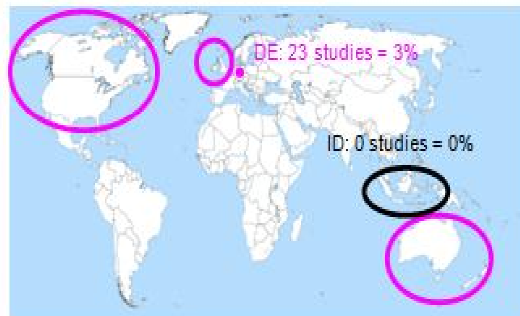
„Only what is published
in english language
will contribute to the huge, globally
available knowledge base. Hanya yang
terpublikasi dlm bahasa Inggris yang
biasanya diketahui secara luas“

B&Z p. VII

Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

1 Data

- 736 meta analyses



Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

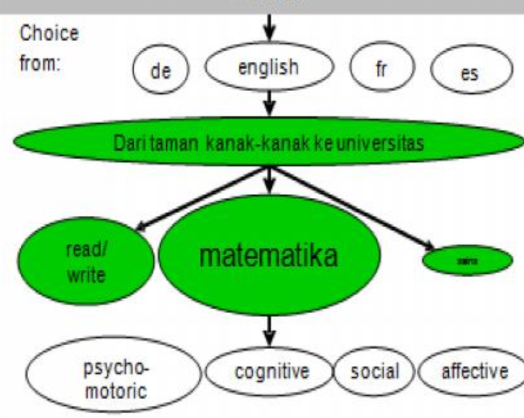
Note of the author
Catatan dari penulis

„You should not draw conclusions
(hastily) from the study…
for non-english speaking areas or
not highly developed countries.“
„Jangan mengambil kesimpulan dari
penelitian yang diambil dari negara non
bahasa Inggris“

Hattie p. 16

Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

1 Data



Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

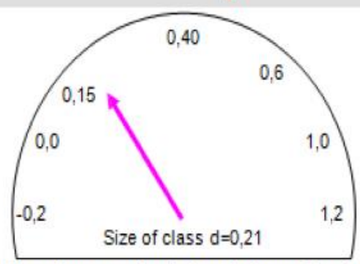
Note of the author

„The major message is
that we need a barometer of
what works best.“

Hattie in his preface

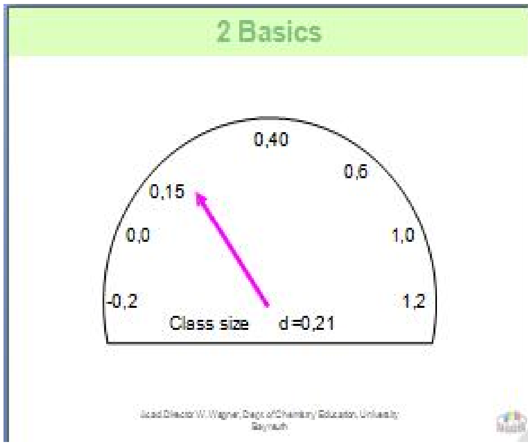
Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

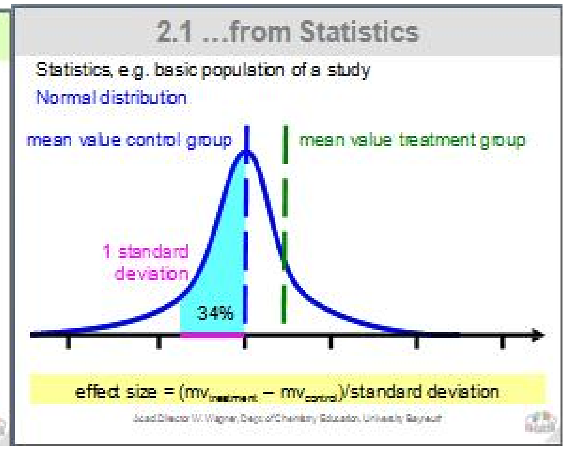
„Smaller classes do not perform better…

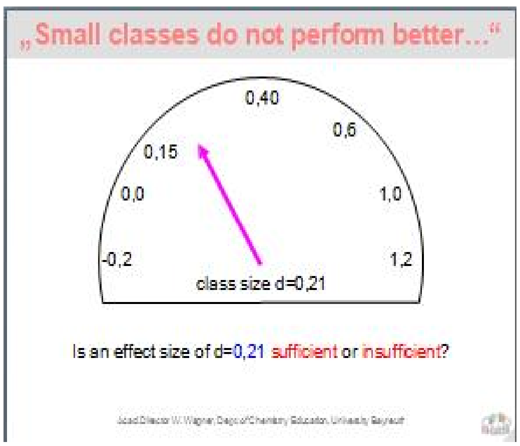


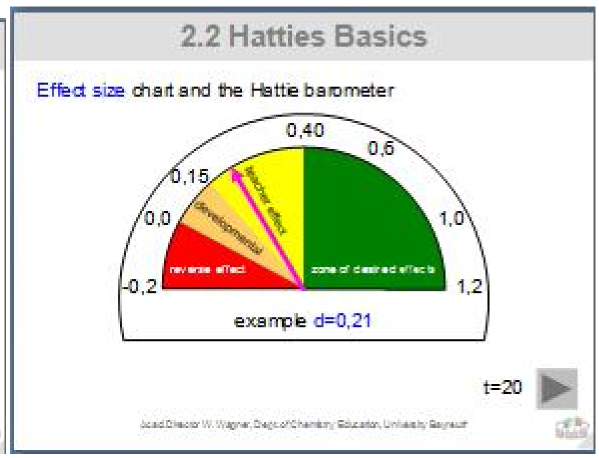
…berdasarkan peningkatan ketrampilan kognitif
in **mathematics**
in **english speaking**,
industrialized countries.“

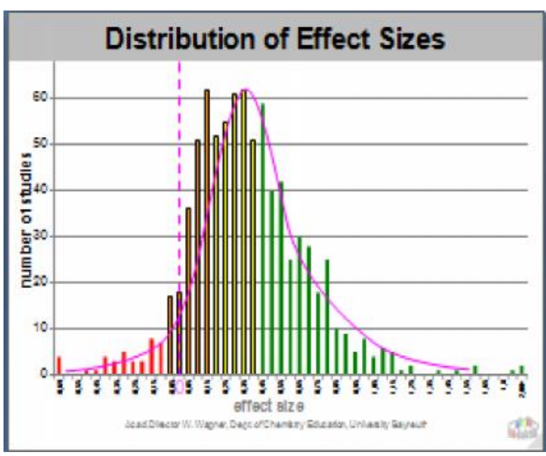
Acad. Director W. Wagner, Dept. of Chemistry Education, University Bayreuth

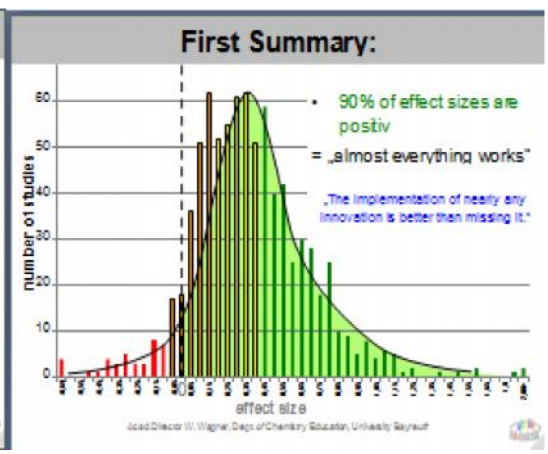

2 Basics
0,40
0,6
0,15
0,0
1,0
-0,2
1,2
Class size d=0,21

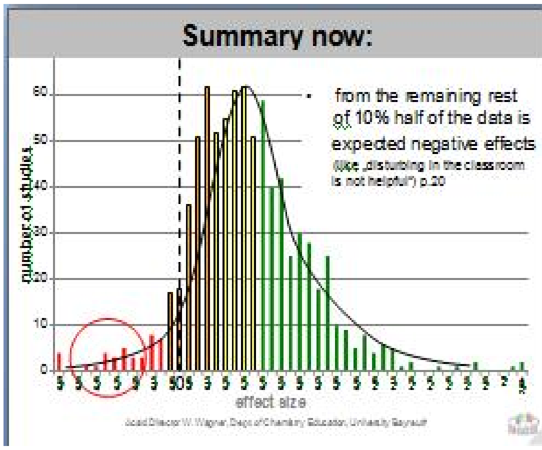

2.1 ...from Statistics
Statistics, e.g. basic population of a study
Normal distribution
mean value control group
mean value treatment group
1 standard deviation
34%
effect size = (mv_treatment – mv_control)/standard deviation

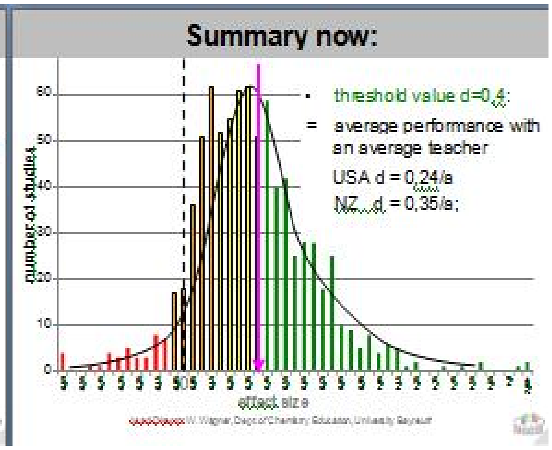

„Small classes do not perform better...“
0,40
0,6
0,15
0,0
1,0
-0,2
1,2
class size d=0,21
Is an effect size of d=0,21 sufficient or insufficient?

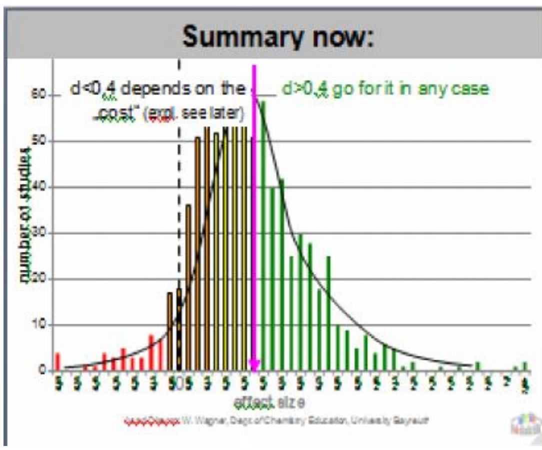

2.2 Hatties Basics
Effect size chart and the Hattie barometer
0,40
0,6
0,15
0,0
1,0
-0,2
1,2
example d=0,21
t=20


Distribution of Effect Sizes
number of studies
effect size


First Summary:
90% of effect sizes are positiv
= „almost everything works"
„The implementation of nearly any innovation is better than missing it."
number of studies
effect size







Three frequent misinterpretations

1. Homework d = 0,29
2. Team teaching d = 0,19
3. Summer holidays d = -0,09

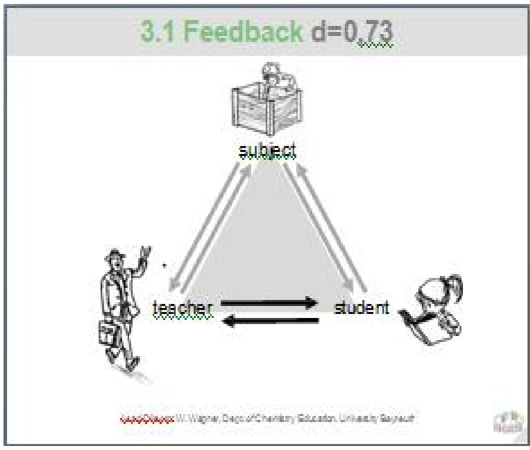
3 Good teaching

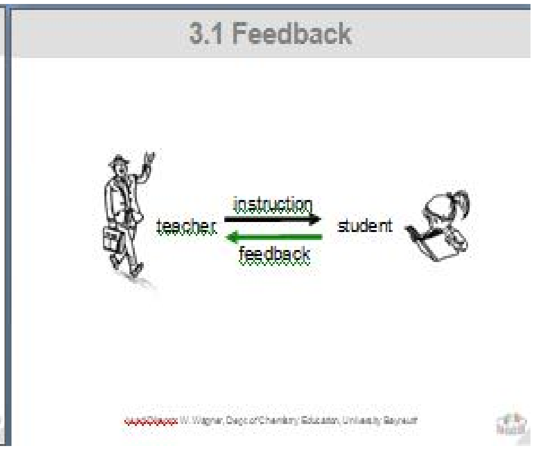
Hattie discusses:

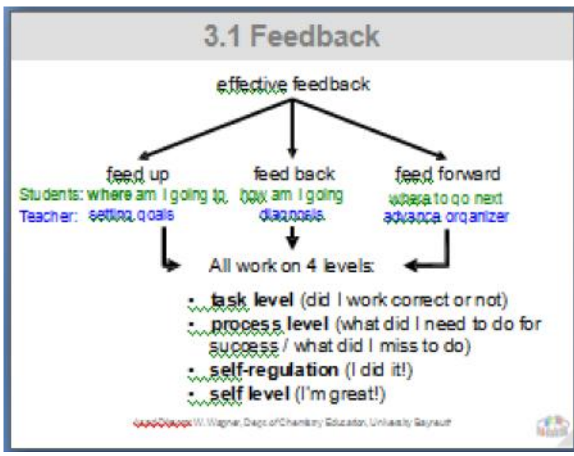
1. Teaching goals	d=0,56
2. Behavioral and advance organizers	d=0,41
3. Concept mapping	d=0,57
4. Mastery learning	d=0,58
5. Kellers PSI	d=0,53
6. Worked examples	d=0,57
7. Feedback	d=0,73
8. Frequent testing	d=0,34
9. Teaching test taking	d=0,22
10. Providing formative evaluation	d=0,90
11. Questioning	d=0,46

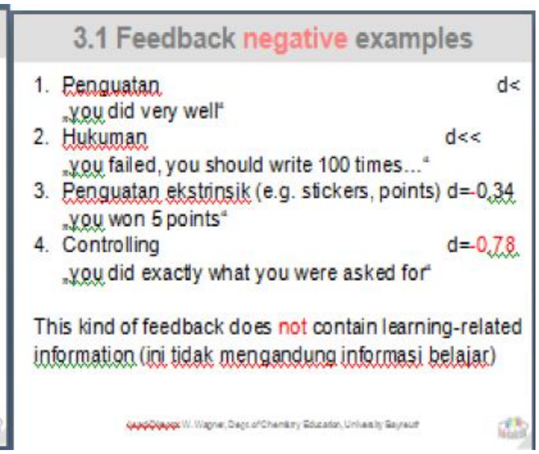
3 Good teaching

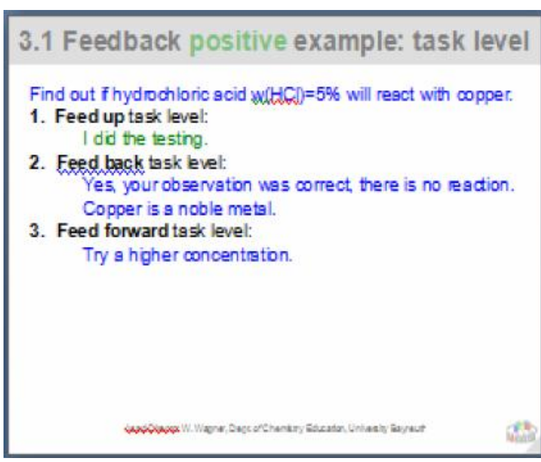
12. Time on task	d=0,38
13. Massed practice	d=0,71
14. Peer tutoring	d=0,55
15. Mentoring	d=0,15
16. Meta-cognitive strategies	d=0,69
17. Study skills	d=0,59
18. Self-verbalization	d=0,64
19. Student control	d=0,04
20. Matching style of learning	d=0,41
21. Individual instruction	d=0,23
22. A	
23. B	

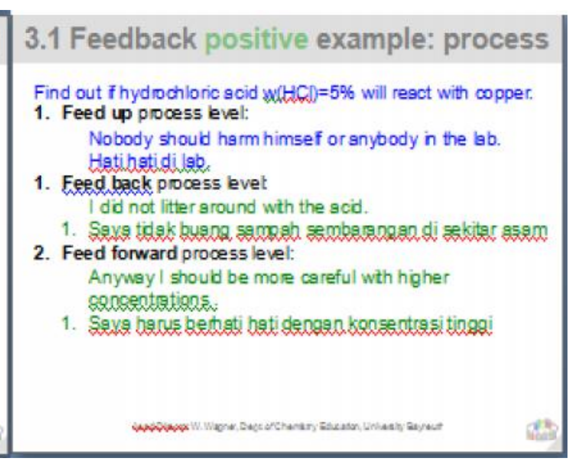

3.1 Feedback d=0,73
subject
teacher
student

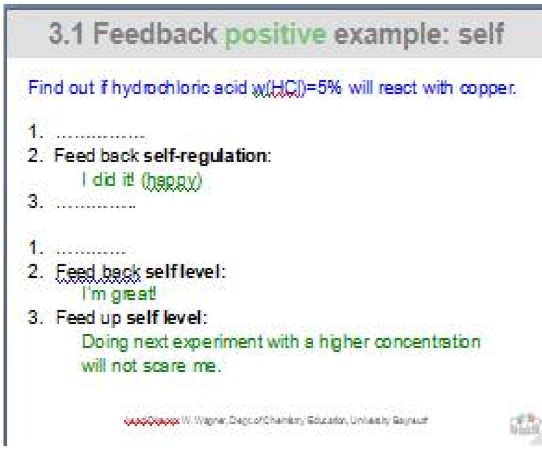

3.1 Feedback
teacher
instruction
feedback
student

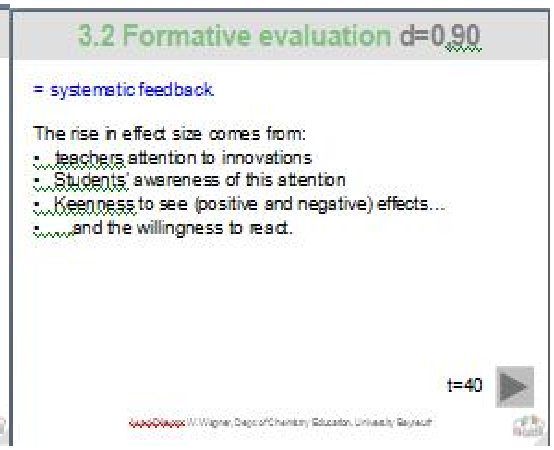

3.1 Feedback
effective feedback
feed up
feed back
feed forward
Students: where am I going to
how am I going
where to go next
Teacher: setting goals
diagnosis
advance organizer
All work on 4 levels:
• task level (did I work correct or not)
• process level (what did I need to do for success / what did I miss to do)
• self-regulation (I did it!)
• self level (I'm great!)

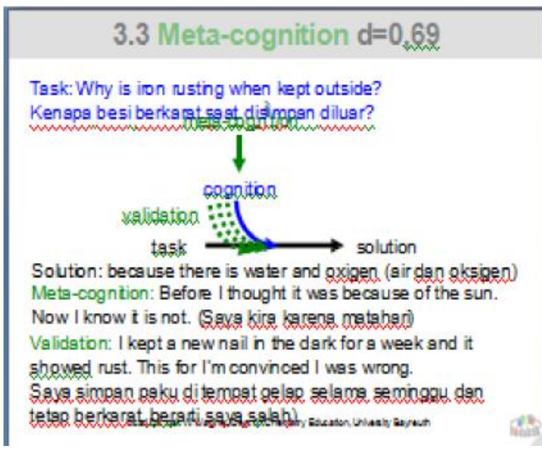

3.1 Feedback negative examples
1. Penguatan d<
„you did very well"
2. Hukuman d<<
„you failed, you should write 100 times…"
3. Penguatan ekstrinsik (e.g. stickers, points) d=-0,34
„you won 5 points"
4. Controlling d=-0,78
„you did exactly what you were asked for"
This kind of feedback does not contain learning-related information (ini tidak mengandung informasi belajar)

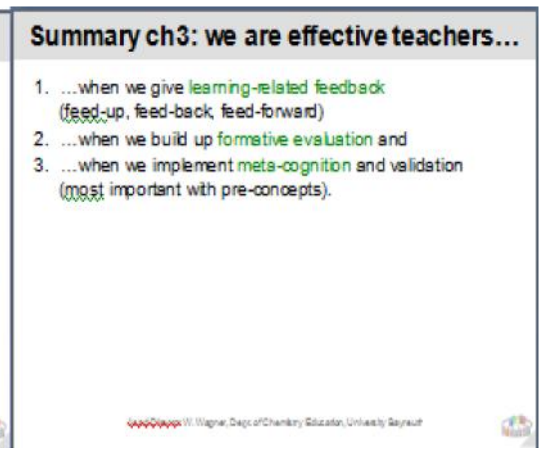

3.1 Feedback positive example: task level
Find out if hydrochloric acid w(HCl)=5% will react with copper.
1. Feed up task level:
I did the testing.
2. Feed back task level:
Yes, your observation was correct, there is no reaction.
Copper is a noble metal.
3. Feed forward task level:
Try a higher concentration.

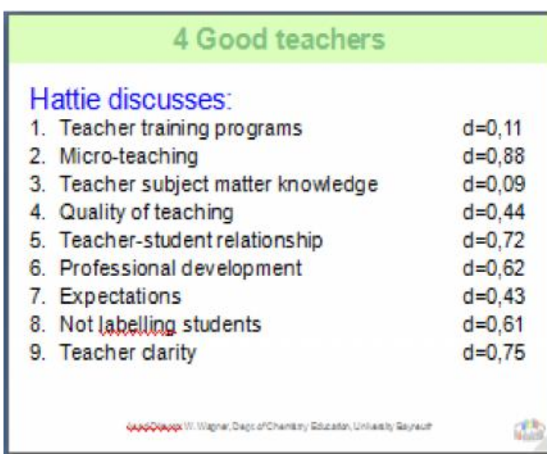

3.1 Feedback positive example: process
Find out if hydrochloric acid w(HCl)=5% will react with copper.
1. Feed up process level:
Nobody should harm himself or anybody in the lab.
Hati hati di lab.
1. Feed back process level:
I did not litter around with the acid.
1. Saya tidak buang sampah sembarangan di sekitar asam
2. Feed forward process level:
Anyway I should be more careful with higher concentrations.
1. Saya harus berhati hati dengan konsentrasi tinggi

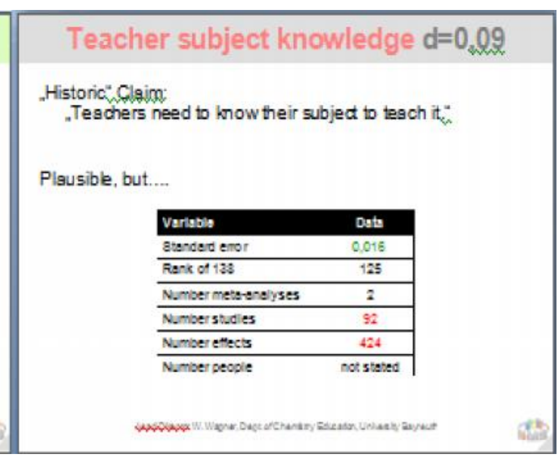

3.1 Feedback positive example: self
Find out if hydrochloric acid w(HCl)=5% will react with copper.
1. ....
2. Feed back self-regulation:
I did it! (happy)
3. ....
1. ....
2. Feed back self level:
I'm great!
3. Feed up self level:
Doing next experiment with a higher concentration
will not scare me.


3.2 Formative evaluation d=0,90
= systematic feedback
The rise in effect size comes from:
• teachers attention to innovations
• Students' awareness of this attention
• Keenness to see (positive and negative) effects...
• ...and the willingness to react.
t=40


3.3 Meta-cognition d=0,69
Task: Why is iron rusting when kept outside?
Kenapa besi berkarat saat disimpan diluar?
meta-cognition
cognition
validation
task
solution
Solution: because there is water and oxigen (air dan oksigen)
Meta-cognition: Before I thought it was because of the sun.
Now I know it is not. (Saya kira karena matahari)
Validation: I kept a new nail in the dark for a week and it
showed rust. This for I'm convinced I was wrong.
Saya simpan paku di tempat gelap selama seminggu dan
tetap berkarat berarti saya salah)


Summary ch3: we are effective teachers...
1. ...when we give learning-related feedback
(feed-up, feed-back, feed-forward)
2. ...when we build up formative evaluation and
3. ...when we implement meta-cognition and validation
(most important with pre-concepts).


4 Good teachers
Hattie discusses:
1. Teacher training programs d=0,11
2. Micro-teaching d=0,88
3. Teacher subject matter knowledge d=0,09
4. Quality of teaching d=0,44
5. Teacher-student relationship d=0,72
6. Professional development d=0,62
7. Expectations d=0,43
8. Not labelling students d=0,61
9. Teacher clarity d=0,75


Teacher subject knowledge d=0,09
„Historic" Claim:
„Teachers need to know their subject to teach it."
Plausible, but....
Variable Data
Standard error 0,016
Rank of 138 125
Number meta-analyses 2
Number studies 92
Number effects 424
Number people not stated

Teacher subject knowledge d=0,09

Some of the variables of 424	d=

Some of the variables of 424	d=
Number of education courses	0,37
Student teaching grade	0,34
Number of years of teaching experience	0,33
Teachers academic skills	~
Verbal ability	~
Skill to develop interpersonal relationships with students	

„If one (of these variables) is missing the effectiveness is reduced by more than a third."
Hattie, chapter 7

0,09

Teacher subject knowledge

He, who can, does.
He, who can not, teaches.

Teacher training programs d=0,11

„There is no set of essential experiences that must be taught, let alone a „correct" order for teaching students to become teachers."
Hattie Ch.7

„…teachers learn how to ignore evidence… training seems to lead to teachers who are reproducers, who teach like the teacher they liked most when they were at school…"
Hattie Ch.7

4.1 Teacher-student relationship

R. Bishop asked:

- students → teacher-student relationship
- parents →
- principals →
- teachers → child attitude, child disposition, child home, child…

about what influences student achievement.
Hattie, chapter 7

Most effective teacher variables

- non-directivity d=0,74
- empathy d=0,68

- respect for what the child brings to the class
- allowing experiencies of the child to be recognized by the class
- listening
- caring
- having positive regard for others.

t=60

4.2 Micro-teaching d=0,88

- Coaching by a subject (chemistry) and an education specialist
- Teaching and video recording of the process.
- Reviewing the record in detail. (D. Allen, 1960)
  - ✓ self-feedback of the trainee
  - ✓ feedback by the teacher trainer

4.2 Micro-teaching in the classroom

1. Coaching: how to solve a problem (directing).
   How to name an organic compound.
2. Let students solve problems of different difficulty level (non-directing). Biarkan siswa menyelesaikan masalah pada level berbeda (non directing)
   Students name some simple and some sophisticated compunds.
3. Reviewing the solving process
   -how did you solve it (non-directing) bagaimana solusinya
   -which solution was great and why (directing) yg mana solusi terbaik dan mengapa.

Some people call it the „sandwich method".

Look up micro-teaching in YouTube

Summary: good teachers...

1. ...keep on learning new methods d=1,09
2. ...know about best effects on teaching d=1,02
   (they listened to my talk ;)
3. ...
4. ...have passion for teaching d=0,90
5. ...use micro-teaching d=0,88
6. ...are good in improvisation d=0,84
7. ...arrange good teacher-student relationship d=0,72
8. ...show respect towards students d=0,61
9. ...

General summary

6 signposts towards excellence in education: chapter 11

1. (Good!) Teachers are among the most powerful influences in learning (willing to be the most powerful will overburden us)
2. Teachers need to be directive and non-directive, caring and full of passion for teaching AND learning.
3. Teachers need to be aware of what every student is thinking (thus „Visible Learning").

Zusammenfassung

4. Feed up: learning intention and success criteria
   Feed back: how well do/did we perform
   Feed forward: where to go next.
5. From single to multiple ideas, help learners construct and reconstruct knowledge and ideas.
6. Principals and teachers need to create school where error is welcomed as an learning opportunity...

Integration of Green Chemistry into Chemistry Subject Matter in Chemistry Departement

Suyono
Chemistry Departement of FMIPA Unesa
email: ionunesa@yahoo.co.id

ABSTRACT

This study aimed to know the readiness of chemistry students who will be pioneer and headway booster in terms of environment in their region. The measurement of students' readinessis based on their understanding of green chemistry concept and orientation of environmental value. The data of student's measurement used as argumentative reason to integrate green chemistry concept into chemistry subject in chemistry department. First, it was assessed by test of conceptwith certainty of response index. Second, it was assessed by questionnaire. The inferences of this study related to (1) the number of chemistry students who had wrong concept of green chemistry, who did not know the concept of green chemistry and who got misconceptions, (2) the orientation of environmental value of chemistry students was not to be expected yet, the majority were still egocentric, and (3) theintegration of green chemistry approach in the lecture had altered students environmental value to be better, their egocentric value declined while their ecocentric value increased.

Introduction

College students are young generation who will be the heirs of virtue, successor of national goal, future leader for nation and pioneer of productive development. Students must be tough, ductile, and heroic so they can overcome challenges, threats, obstacles and interferences. If each students in the unversity become tough, they will internalize environtmental sustainability. If there are more than one university in the area which have environtmental sustainability, these will internalize regional sustainability, and so on. Tough students will be able to internalize national sustainability. They will be able to promote their region. This should be applied for students in East Kalimantan as well.

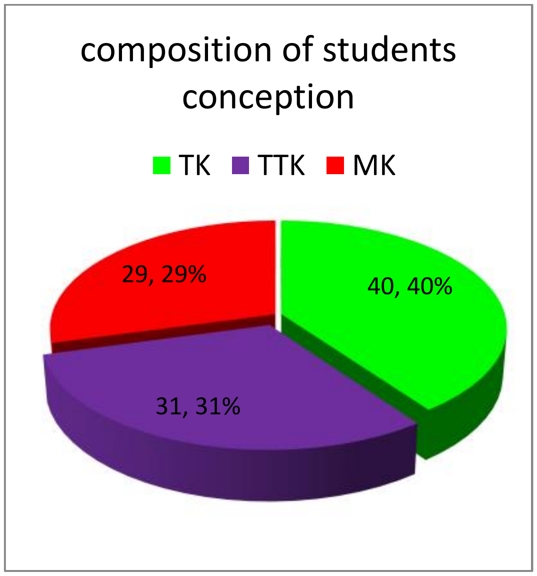
One of the challenges students need to consider is their role to overcome the destructive behavior of society in the environment. Destructive behavior of society on the environmentis one of obstacles that must be overcome for advance of the area.

According to the data reported by the National Disaster Mitigation Agency (BNPB), the number of ecological disasters and climate change such as floods, landslides, and forest fires in a decade (2002-2009) is higher than the number of geological disaster such as volcanic eruptions, earthquakes, and tsunami. In addition, air pollution of industrial waste gases and transportation place Indonesia in the third ranks as the country with the world's largest gas emissions that contribute to global warming (Measey, 2010). Moreover, the number of dead marine life increased significantly because of the harmful substance through food chain. Therefore, the destructive human behavior is a key factor of the significant ecosystem degradation (Vlek and Steg, 2007).

Chemistry students especially have to participate to protect the environment including prevention of ecosystem degradation. Students must play an active role in environmental protecting effortsthrough understanding and experiences concept of green chemistry. Green chemistry is the utilization of a set of principles that will help to reduce the use and generation of hazardous substances during the manufacture and application of chemical products. Green chemistry aims to protect the environment not by cleaning up, but by inventing new chemical processes that donot pollute. It is arapiddevelopment andanimportant area in the chemical sciences. Principles of green chemistry, developments in this field and some industrial applications are discussed (Badami, 2008).

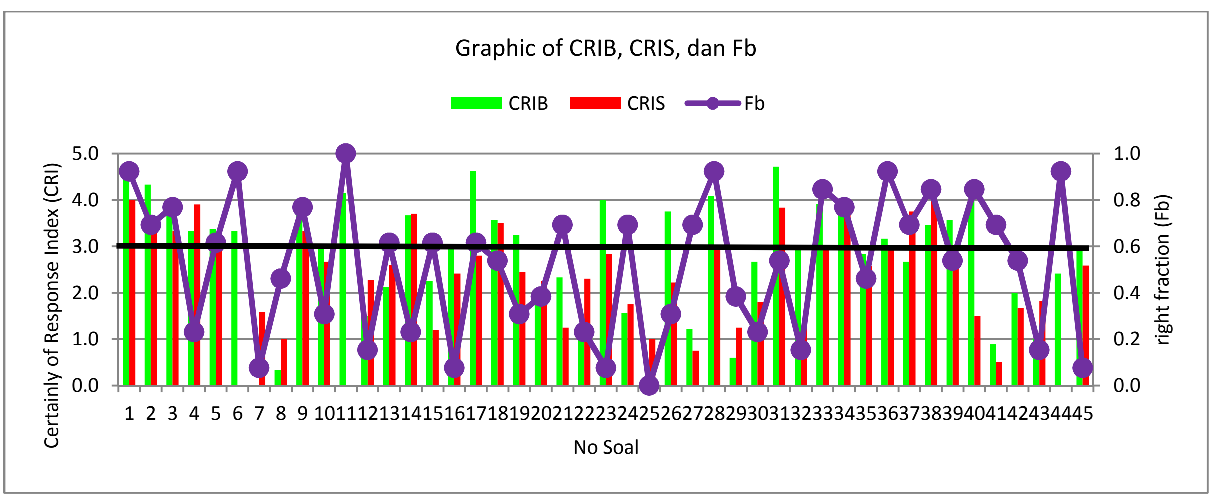
Understanding of chemistry students on the concept of green chemistry is a main capital to raise students interesting, as younger generation on environmental issues through the conceptualization of environmental problems and the development of cognitive framework regarding the environment. For instance, they are expected to be the graduates who are ready to become agents of change in society and able to face and cope with a variety of complex environmental problems (Teksoz, Sahin, and Ertepinar, 2010). Readiness of young people in solving environmental problems is based on their positive behavior in the environment. Lack of understanding and misconception on green chemistry concept can disturbtheir positive behavior towards the environment.

Suyono (2015) finds that the number of chemistry students don’t know the concept (TTK) and have wrong concept (misconception, MK) on green chemistry concept. The supporting data, can be seen at Picture 1.



Picture 1 composition of students conception on green chemistry concept

At Picture 1, it can be seen that 31% of chemistry students TTK and 29% MK on green chemistry concept. Half of green chemistry concept tested, is misunderstood by large number of chemistry students. The data that support the statement can be seen at Picture 2. Based on this data, it concludes that there is aproblem or obstacle in generating student interest to succeed the green chemistry making.



Picture 2 The Large Number of Chemistry Students had Misconception at 23 Item Test on Green Chemistry Concept

Besides, the chemistry student understanding of green chemistry concept are still low, it is found also by Wahyuningsih (2014), other students have bad behaviour to the environment.Many types of environmental value orientations proposed by psychologists and even some the terms overlap each other. Therefore, the researchers determine three environmental value orientations, namely egocentric, homocentric, and ecocentric (Dietz et al., 2005). The three orientations perceived by researcher have represented the most basic determinant factor of attention and attitude toward environment. Egocentric orientation is a type of environmental values in which a person tends to be more individualistic and just think of their own interests rather than environmental conditions. Different from egocentric, homocentric considers environment as the basic of humanity. The last type is ecocentric who value the environment as a unity of ecosystem that deserves attention as a whole. The intrinsic value of the environment would be the basis of ecocentric person to dedicate themselves to the environment. Data by Wahyuningsih (2014)find only about 39.13% of those who have ecocentric value orientation, 34.78% are homocentric value orientation, and 95.65% of them tend to be egocentric people.

Outside of the campus, students are part of society.In fact, awareness and insight of Indonesian society on a sustainable environment is relatively low. It can not regardless from most of the environmental problems being faced by Indonesia as a developing country. Most human activities related to the environment to fulfill their needs do not pay attention on the impact in the future (Schultz and Zelezny, 2000).This condition will aggravate students’ understanding of environment protecting effort.Conditions of these communities will worsen students' understanding to protect an environment. There is an anxiety that who do not have a correct understanding of green chemistry concept, especially misconceptions and live in a society that have not concern in the environment will have counter-productive environmental values to practice green chemistry concept. This problem as it must be solved because if it is solved, student will not be able to support the Green Chemistry program to build the advanced Kaltim.

Integration ofGreen Chemistry into Lecturing Process

The most appropriate solution to improve chemistry students' understanding ofgreen chemistry concept should be agreed. The true understanding someone’s has been proven affecting their mindset, which then encolor their life in society. Someone who understands green chemistry concept correctly is expected to have a positive mindset and attitude which will further benefit the environment protection.

Chemistry education curriculum which has not integrates the efforts to explain green chemistry, improve attitudes and values to students must be innovated. Chemistry education curriculum should be created till impacton the formation of positive attitudes towards the environment.A positive behavior on the environment is deeply rooted in environmental values (Rokeach, 1973). Environmental values can actually be internalized by lectures through the learning process so that it becomes meaningful learning experiences for students (Jonsson and Nilsson, 2011). Environmental values that have been embedded will be further developed into a hierarchy or priority level of some beliefs and norms that can guide someone in decision-making and behave towards the environment (Stern, 2000).

One way that can be applied by lecturer to embed environmental values into their college students learning experience is through the integration of Education for Sustainable Development (ESD) into the education system. ESD is an educational vision to introduce and apply sustainable development in an effort to develop the knowledge and skills needed for the nature sustainability in the future as well as change the **value of orientation**, behavior, and lifestyle through a holistic, integrated and interdisciplinary approach (UNESCO, 2009). ESD has been introduced into curriculum and become part of the education system in several European countries such as, Britain, Denmark, Netherlands, and France to increase students' awareness of environmental issues (Rioux, 2011).

Chemistry is closely related to human life. The role of chemistry is very great in helping to improve the quality of human life, mainly in the social, industry, and economy (Udoh, 2012). Chemistry can be means utilizing of natural resources utilization in order to satisfy human needs. Yet, the process, production, and use of chemicals itself have caused some environmental problems, such as pollution, depletion of natural resources, and health problems. Therefore, these problems should be topics discussed and studied by students dealing with chemistry learning (Prodjosantoso, 2011). Student may not have a deep understanding about environmental problems though they have great attention to environment (Fien et al.,2002). Looking at the reality, prospective chemistry lecturer should be equipped to have sufficient insight and knowledge about the environment in order to bring chemistry learning more relevant to the environment by making change in their environmental value orientation.

The Chemistry Education Program, State University of Surabaya is one of the educational institutions in Indonesia, which is started to introduce Green Chemistry approach in General Chemistry course in order to integrate ESD into the curriculum of teacher education in the academic year 2013/2014. Green Chemistry approach is the application of chemistry to prevent pollution and reduce waste. Prevention of pollution through Green Chemistry emphasises on the use of materials and processes that can reduce and minimize the production of waste or pollutants. These include reducing the use of hazardous materials and protect the natural resources through the efficient use (EPA, 1990). According to Parrish (2007), Green Chemistry approach can encourage prospective chemistry teachers to learn how to cope with environmental problems because they are empowered to resolve these problems.

In practice, the application of Green Chemistry approach is based on the 12 principles (Anastas and Wagner, 1998). The principles of Green Chemistry are prevention, atom economy, less hazardous chemical synthesis, designing safer chemicals, safer solvents and auxiliaries, design for energy efficiency, use a renewable feedstocks, reduce derivatives, catalyst, design for degradation, real-time analysis for polluting prevention, and inherently safer chemistry for accident prevention. To understand each of these principles, chemistry students need to be introduced through an experiment process in laboratory.

Learning environment can not be separated from the process of learning chemistry is laboratory learning environment. Chemistry learning uses the principles of Green Chemistry that be a meaningful learning if chemistry students are engaged directly in an experiment using safe and non-hazardous materials to construct their own understanding of a phenomenon in daily life to master an environmentally and friendly chemical process (Tobin, 1990). Chemistry students are highly expected to have a better understanding, insight, and awareness toward environment as a teacher who will bring more relevant chemistry learning because environmental value can be embedded indirectly after they are introduced with Green Chemistry laboratory learning. The application of Green Chemistry laboratory learning can play an important role in addressing environmental issues through education by changing the environmental value orientation of chemistry students who will greatly affect young people's positive attitudes and behavior toward the environment.

Teaching and Learning Strategy for Green Chemistry Approach

Integrating the Green Chemistry approach into chemistry course is indirectly required a model to infuse education for sustainable (ESD) throughout the curriculum. Regarding to the result of past studies about the application of Green Chemistry approach, this relevant environmental approach enables development of higher order cognitive skills such as communicative skill, problem solving skill, and decision making ability (Anne, 2007). Based on the research finding, the relevant UNESCO educational module states examples of some important skills for ESD, for instance, the skills of communication, problem solving, personal, and social skills (Agashe, 2004). In addition, Ghosh (Mitakidou and Tamoutseli, 2011) proposed several abilities promoted by ESD, such as decision making, conflict management, initiative for action, personal and social communication abilities and the development of mutual trust and acceptaingthe difference. The development of these relevant skills, attitudes, and values can be achieved effectively by the using Cooperative Learning strategies.

According to Ghosh (Mitakidou and Tamoutseli, 2011), cooperative learning is one of the best methods for the successful application of ESD. A majority of Cooperative learning strategies have an in-built provision for decision-making by the learners while they work on their assigned task. Choices made by the individuals are implemented by the group and therefore, usually only the choices aimed at the common good are implemented. Thus, the students learn to consider the common good when making decisions and choices. Making decisions with a consideration for the common good is a step to a sustainable future (Agashe, 2004). In this way, cooperative learning can contribute to an overall increases in motivation and promotion of cognitive development, enhancement of lifelong learning skills, and preparation of students for their future life (Millis in Mitakidou and Tamoutseli, 2011).

Cooperative learning model is developed to accomplish at least three learning objectives, they are student learning outcomes, tolerance, acceptancing the differences and the development of social skills. Student learning outcomes will increase in line with the interaction of students in a group such as cooperation and mutual assistance among members of the group. The first goal of cooperative learning is empirically supported by research conducted by Pandey and Kishore (2010) that reward students for the successful group may be a strong reason for the significant increase in the total level of knowledge and science learning achievement in cooperative learning groups. The second objective focuses on bring an attitude of tolerance and acceptance of differences in accordance with intergroup relations which attempted to shape a class and teaching processes to reduce intergroup prejudice and increase the acceptance of diversity. By cooperating and interacting within a group, the diversity of students in terms of ethnicity, race, religion, ability and cognitive skills are not a barrier to success of the group. The third purpose of cooperative learning is to develop social skills. This last purpose deals with the social psychology theory proposed by Dewey and Thalen. Dewey (in Arends, 2012) asserts that teachers need to create a social system characterized by democratic and scientific processes in a learning environment of learners in the class. Empirically, the research finding from Ajaja and Eravwoke (2010) reports that students regularly show a responsible attitude towards the learning process of other group members because of the presence of feedback, reinforcement and support from colleagues in the group. This feature seems in line with the general view that a person can change his attitude through social interaction with others.

Empirical Evidence of Positive Impact from Integration of Green Chemistry Approach

Wahyuningsih (2014) has prove that integration of green chemistry approach into general Chemistry subject has positif impact on students' environmental valueorientationin chemistry education departement of unesa.

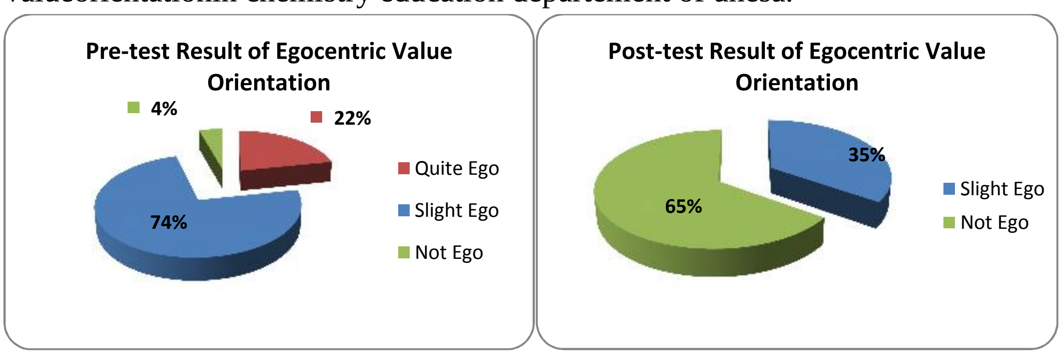


Figure 3 The Change of Egocentric Value Orientation

Figure 3 describes that the dominant category of egocentric value orientation initially possed by students in the pretest was "slight ego", continued by "quite ego" and "not ego." It means that most of their environmental concerns were still focused on their own benefits before being introduced by Green Chemistry principles. However, in the posttest, the result was changed. None of students had "quite ego" category. The dominant category of this value orientation became "not ego" and followed by little "slight ego." The result indicates that after participating into the learning process, prospective chemistry students' egocentric value shifted to more environmental.

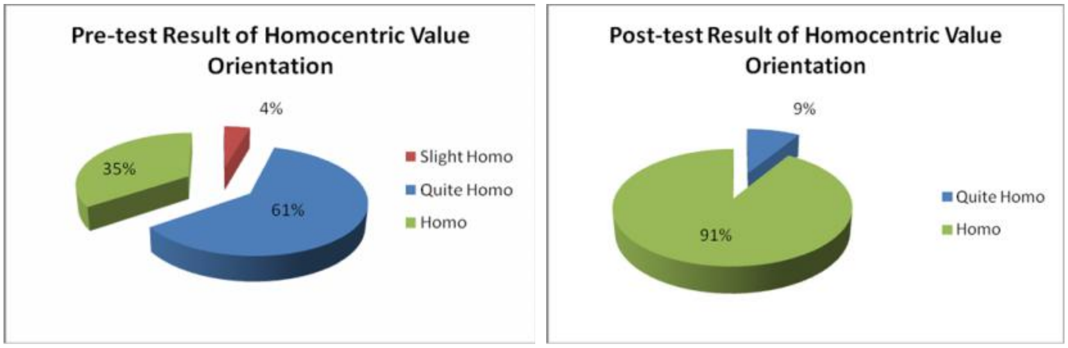


Figure 4 The Change of Homocentric Value Orientation

Figure 4 illustrates that homocentric value of chemistry students was still dominantly expressed "quite homo" criteria, followed by "homo" and "slight homo" categories in the pre test result. This result means that their attention to the environmental sustainability for human life was still low before involving to the learning process. In contrast, the posttest result was surprisingly changed. None of them had "slight homo" category. Most of them were categorized as "homo" category, while less than 10% of them were classified into "quite homo" category. The result proves that after engaging into the Green Chemistry laboratory learning, prospective chemistry students had sufficient insight regarding to environmental protection for human life.

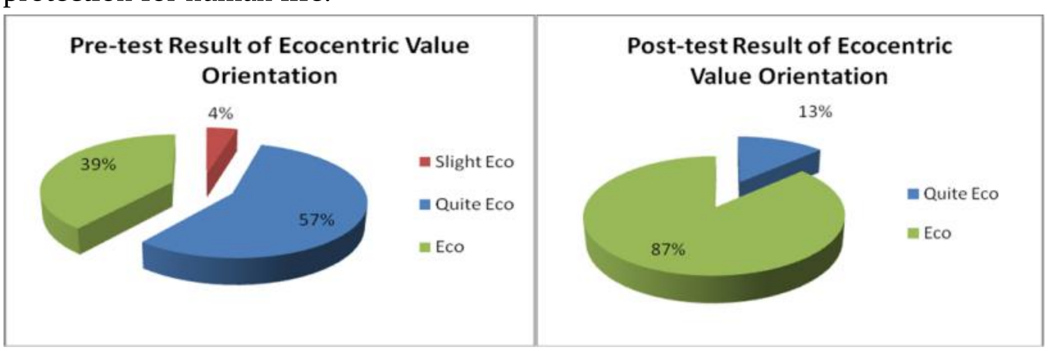


Figure 5 TheChange of Ecocentric Value Orientation

Figure 5 shows clearly that chemistry students, having "eco" category of ecocentric value, were still low, less than 40%, while the dominant category possessed by them was "quite eco"category. It can be concluded that before being the participant of Green Chemistry laboratory learning, their attention to protect the environment was generally not aimed yet for whole ecosystem. Contrast to the pretest result, in the posttest, almost 87% of themwere classified having "eco" category of this value, while "quite eco" category was only possessed by less than 15% of them. It proves that after joining to the learning process, they have understood well related to protecting the environment for sustainability of the whole ecosystem.

Conclusion

This study concludes some components such as, (1) the number of chemistry students who had wrong concept of green chemistry, the others did not know the concept of green chemistry and even others students got misconceptions, (2) the orientation of chemistry students environmental value is beyond the expectation, the most of the students are still egocentric, (3) society awareness to environmental protection are low, and (4) the integration of green chemistry approach in the lecture have to be proven succesfully to change students' envronmental value batter, in which egocentric value decreased, the ecocentric increased.

Recomendation

Three conclusions aboveare called as three conditions that are less favorable to support the development of an area, especially when it is viewed from the environmental aspect. The improvement of chemistry students' understanding of green chemistry concept and their orientation of environmental value was done by integrating green chemistry approach into lectures in chemistry education department. A solution suggested to curriculum developers in the department of chemistry is to prepare students in order to contribute sustainable development in their regions.

References

Agashe, Lalita. (2004). Sustainable Development and Cooperative Learning in the Formal Education System in India. Accessed from http://lalitaagashe@rediffmail.com on September, 7th 2014.

Ajaja, O. Patrick and Eravwoke, Ochuko Urhievwejire. (2010). "Effects of Cooperative Learning Strategy on Junior Secondary School Students Achievement in Integrated Science". *Electronic Journal of Science Education*. Vol. 14, No. 1.

Anastas, P. T., and Warner, J. C. (1998). *Green chemistry: Theory and Practice*. Oxford: Oxford University Press.

Anne, P. (2007). "Toward The Greening of Our Mind: A New Special Topics Course". *Journal of Chemical Education*.Vol.84, No.2, pp. 245-247.

Arends, Richard I. (2012). *Learning to Teach*. Ninth Edition. New York: McGraw-Hill.

Badami, Bharati V. 2008. **Concept of Green Chemistry; Redesigning Organic Synthesis**. *Resonance* Edisi November 2008, p. 1041-1048.

Dietz, T., Fitzgerald, A. and Shwom, R. (2005). Environmental Values. *Annual Review of Environmental Resources*. Vol. 30, pp. 335–372.

Environment Protection Agency, EPA. (1990). 12 Principles of Green Chemistry. Access on Juny, 10th 2013 from www.epa.gov/greenchemistry.

Fien, J. 2002. Education and Sustainability: reorienting Australian School for a Sustainable future. Tela Papers. No. 8. Australian Conservation Foundation. Melbourne.

Jonsson,Anna-Karin Engqvist and Nilsson, Andreas. (2011). Exploring the Relationship between Values and Pro-Environmental Behavior: *The Influence of Locus control*. Department of Psychology: University of Gothenburg.

Mitakidou, Soula and Tamoutseli, Konstantia. (2011). "Engaging Learners in Cooperative Learning through Environmental and Cross-Cultural Activities". *Journal of Teacher Education for Sustainability*. Vol. 13,No. 1, pp. 5–18.

Parrish, A. (2007). "Toward The Greening of Our Mind: A New Special Topics Course". *Journal of Chemical Education*. Vol 84, pp. 245–247.

Prodjosantoso, A. K. (2011). Peran Pendidikan Kimia dalam Mengatasi Pencemaran Lingkungan. Yogyakarta: Jurdik Kimia FMIPA Universitas Negeri Yogyakarta.

Rioux, Liliane. (2011). “Promoting Pro-Environmental Behavior: Collection of Used Batteries By Secondary School Pupils”. *Environmental Education Research*. Vol. 17, pp. 353-373.

Rokeach, M. 1973. *The Nature of Human Values*. New York: Free Press.

Schultz, P. Wesley and Zelezny, Lynnette C. (2000). “Promoting Environmentalism”. *Journal of Social Issues*. Vol. 56, No. 3, pp. 363-371.

Stern, P. C. (2000). “Toward a Coherent Theory of Environmentally Significant Behavior”. *Journal Social Issues.* Vol56, pp. 407–24.

Teksoz, Gaye., Sahin, Elvan., and Ertepiner, Hamide. 2010. “A New Vision for Chemistry Education Students: Environmental Education”. *International Journal of Environmental & Science Education*. Vol. 5, No. 2, pp. 131-149.

Tobin, K.G. (1990). “Research on Science Laboratory Activities: In Pursuit of Better Questions and Answers to Improve Learning”. *School Science and Mathematics.* Vol.90, pp. 403-418.

Udoh, Akpan Oko. (2012). “Learning Environment as Correlates of Chemistry Students’ Achievement in Secondary Schools in Akwa Ibom State of Nigeria”. *An International Multidisclipinary Journal Ethiopia.* Vol. 6, No. 3, pp. 208-217.

UNESCO. (2009). *Review of Contexts and Structures for Education for Sustainable Development*. Paris: Division for the Coordination of United Nations Priorities in Education.

Vlek, Charles and Steg, Linda. 2007. “Human Behavior and Environmental Sustainability: Problems, Driving Forces and Research Topics”. *Journal of Social Issues*. Vol. 63, No. 1, pp. 1–19.

Wahyuningsih, Arini. 2014. The Effect of Green Chemistry Laboratory Leraning on Pre-service Chemistry Teachers’ Environmental Value Orientations and Creative Thinking Skill. Thesis. Surabaya: Universitas Negeri Surabaya.

Hierarchically structured natural fibres as platform for point of care assays

Dedy H.B. Wicaksono
Medical Devices and Technology Group (Mediteg) and Dept. Of Clinical Sciences,
Faculty of Bioscience and Medical Engineering
Universiti Teknologi Malaysia
V01, UTM, Skudai 81310,
Johor, Malaysia

Email: dedy.wicaksono@biomedical.utm.my

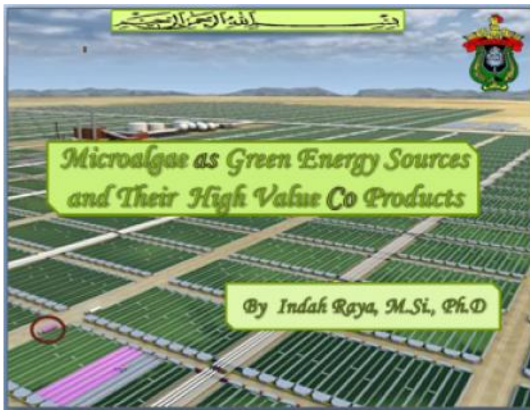
ABSTRACT

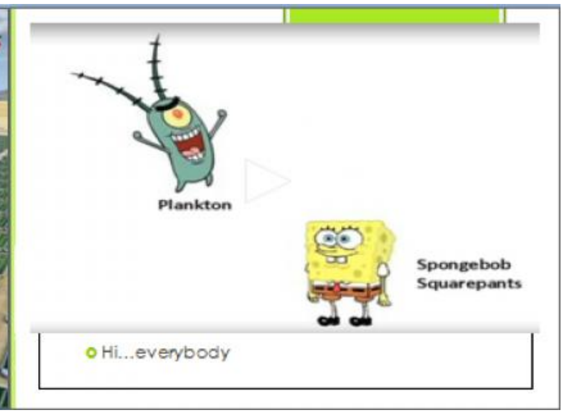
Cotton fabric is proposed as an alternative material for low cost point of care devices. Cotton fabrics are vastly available, low cost and flexible. Simple wax patterning method was applied to create hydrophilic channels in cotton fabric. Three-dimensional (3-D) colorimetric microfluidic device was made by folding 2-D pattern along certain predefined lines. 3-D devices show better mixing uniformity between reagents and analyte across the detection zones. On-chip colorimetric calibration is also proposed by putting predefined serially diluted samples next to the detection zones. Multiple assays can be integrated within a small surface area by stacking layers of individual assay device separated by a wax-impregnated fabric. Cotton fabric was also used as a platform for conducting Enzyme-Linked Immunosorbent Assay (ELISA). The colorimetric performance is similar to the conventional absorbance-based ELISA, yet with lower cost and shorter time to get results. A second type of device using electrochemical detection principle is also implemented in cotton fabric with three-electrode configuration (working, counter and reference electrode), using similar simple and low-cost wax-patterning. In both colorimetric and electrochemical device, comparison with te already popular paper-based device will be discussed. Finally, we present latest results in our lab in which cotton fabrics were used as a novel platform for cell-based assay and cell-manipulation device.

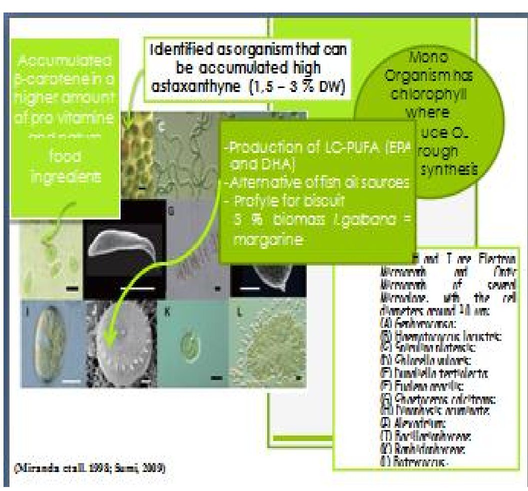
Indah Raya

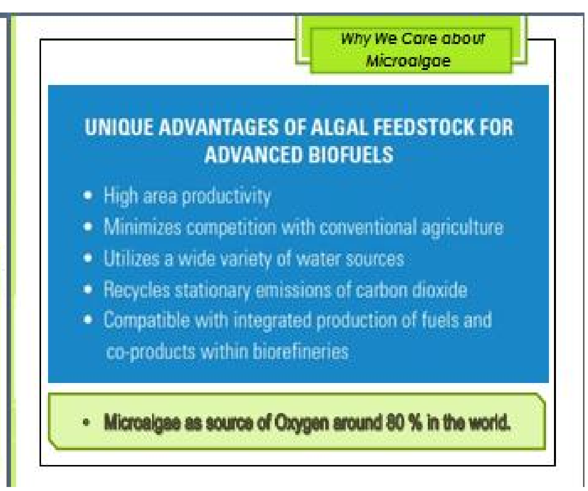
Pembicara Utama

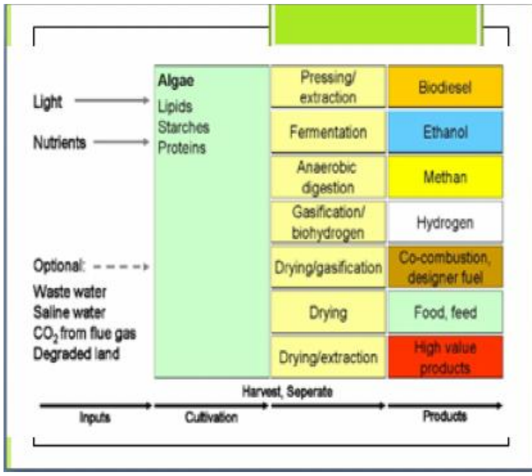
PAPARAN PRESENTASI



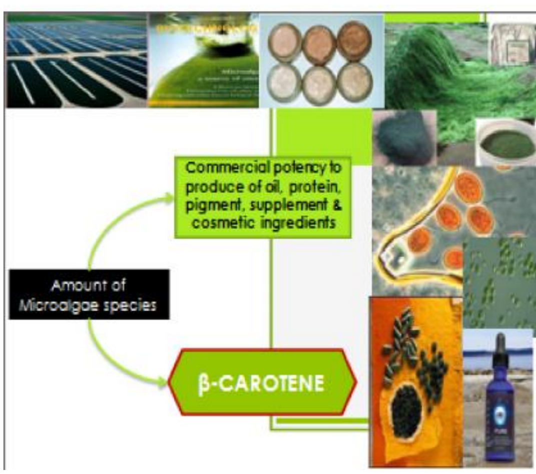


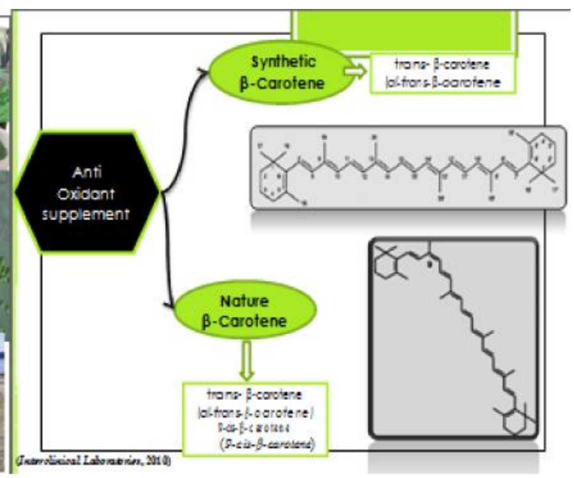


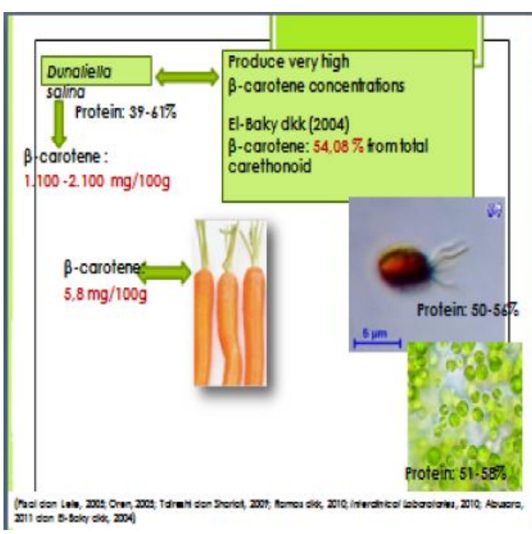



Algae
Lipids
Starches
Proteins
Light
Nutrients
Optional:
Waste water
Saline water
CO_2 from flue gas
Degraded land
Pressing/ extraction
Fermentation
Anaerobic digestion
Gasification/ biohydrogen
Drying/gasification
Drying
Drying/extraction
Biodiesel
Ethanol
Methan
Hydrogen
Co-combustion, designer fuel
Food, feed
High value products
Harvest, Seperate
Inputs
Cultivation
Products


Objective of the project
C. vulgaris
+ High Value Co Products
Adding Fe^{2+},Zn^{2+} & Cu^{2+}
P. cruentum
Dunaliella salina


Commercial potency to produce of oil, protein, pigment, supplement & cosmetic ingredients
Amount of Microalgae species
β-CAROTENE

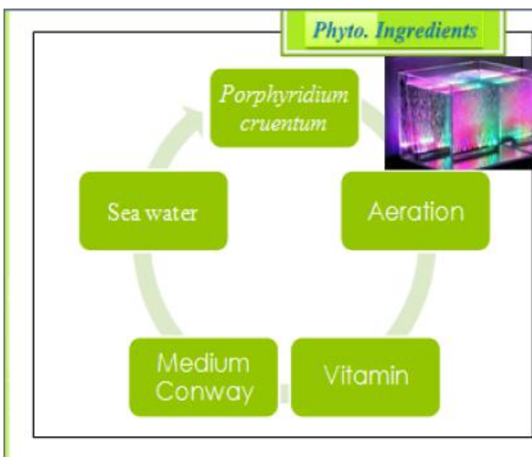

Synthetic β-Carotene
trans- β-carotene (all-trans-β-carotene
Anti Oxidant supplement
Nature β-Carotene
trans- β-carotene (all-trans-β-carotene)
(Interclinical Laboratories, 2010)


Dunaliella salina
Protein: 39-61%
β-carotene :
1.100 -2.100 mg/100g
Produce very high β-carotene concentrations
El-Baky dkk (2004)
β-carotene: 54,08 % from total carethonoid
β-carotene
5,8 mg/100g
Protein: 50-56%
Protein: 51-58%
(Fasol dan Lele, 2005; Oren, 2005; Tafreshi dan Shariati, 2009; Ramos dkk, 2010; Interclinical laboratories, 2010; Abusara, 2011 dan El-Baky dkk, 2004)

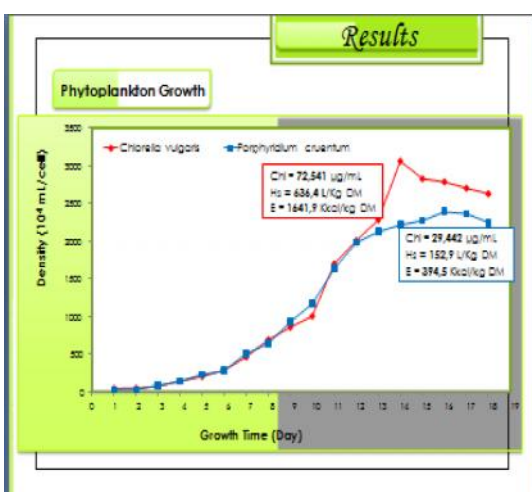

Method
Apparatus

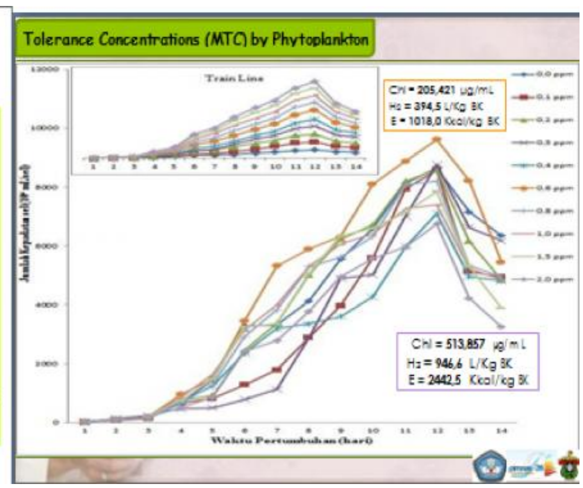

Jar
Container
Aerator
Centrifuge
Ultrasonic
Evaporator
Analytical balance
Desicator
Water bath
Salinometer

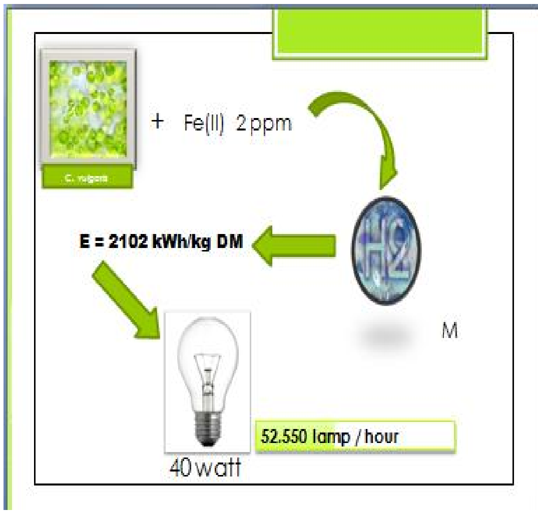

Material
Alkohol 70%
C. vulgaris
P. cruentum


Phyto. Ingredients
Porphyridium cruentum
Aeration
Vitamin
Medium Conway
Sea water


Activity in Laboratory


Results
Phytoplankton Growth
Chlorella vulgaris
Porphyridium cruentum
Chl = 72,541 μg/mL
Hc = 636,4 L/Kg DM
E = 1641,9 Kkal/kg DM
Chl = 29,442 μg/mL
Hc = 152,9 L/Kg DM
E = 394,5 Kkal/kg DM
Density (10⁴ mL/cell)
Growth Time (Day)

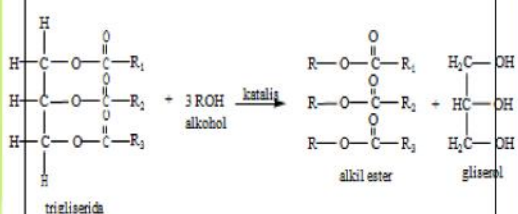

Tolerance Concentrations (MTC) by Phytoplankton
Train Line
Chl = 205,421 μg/mL
Hc = 394,5 L/Kg BK
E = 1018,0 Kkal/kg BK
Chl = 513,857 μg/mL
Hc = 946,6 L/Kg BK
E = 2442,5 Kkal/kg BK
Waktu Pertumbuhan (hari)



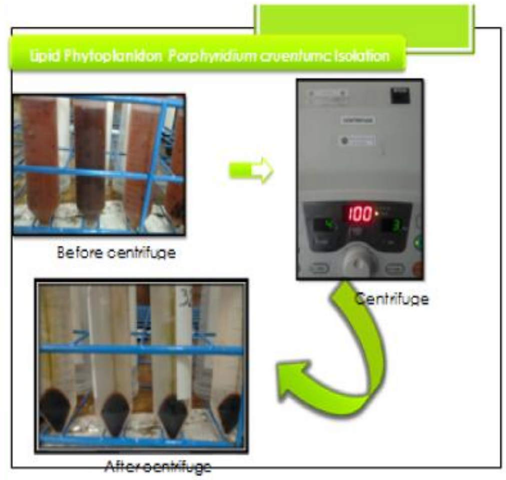
The Hydrogen potensy produce by Phytoplanctone *Chaetoceros calcitrans, Chlorella vulgaris, Dunaliella salina,* dan *Porphyridium cruentum.*

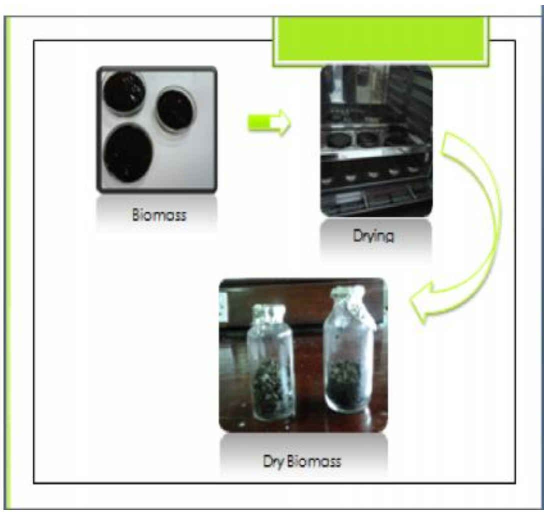
No	Spesies Fitoplankton	Biomassa kering (g)	Kepadatan Sel (10^3 sel/mL)	Total Klorofil (µg/mL)	Potensi H_2 Terhasilkan (L/kg BK)	Energi (Kcal/kg BK)
1	C. calcitrans	0.9568	1238	16.888	202.8	523.2
2	C. vulgaris	1,4187	3060	72.541	636,4	1641,9
3	D. salina	1,1778	518	57.288	626.2	1615.5
4	P. cruentum	2.3965	2287	27.462	152.9	394.5

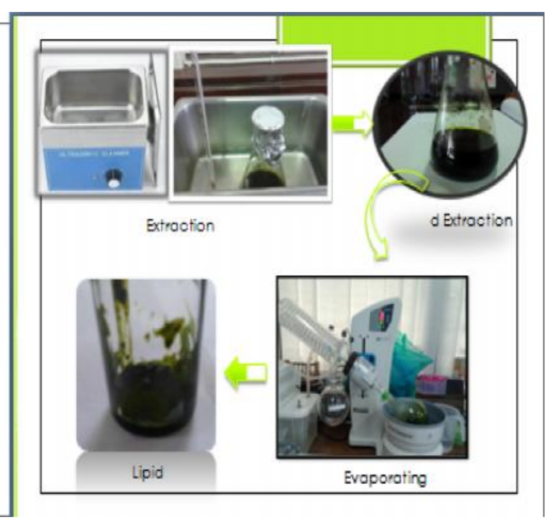
Biodiesel

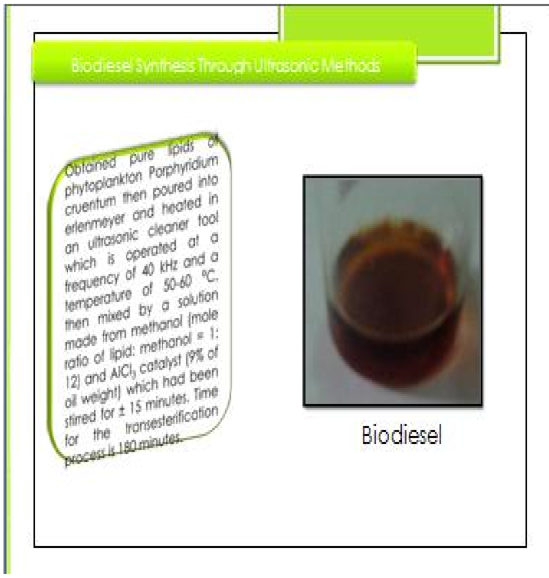


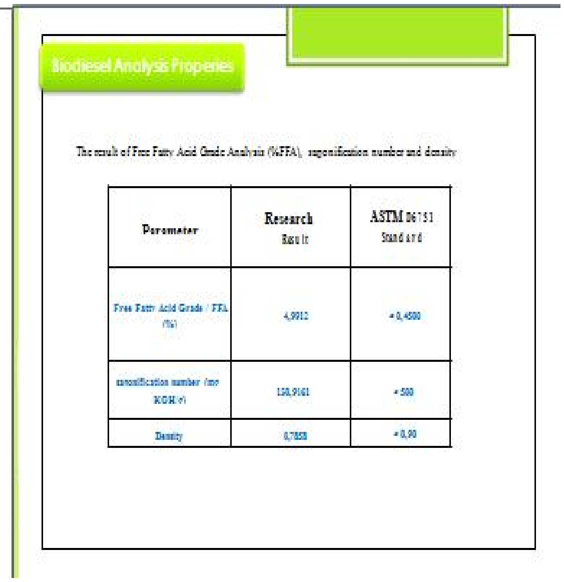
Bayu, A., 2010, Biodiesel dari Mikroalga Laut: Potensi dan Tantangan, *Oseana*, XXXV (1): 15-24.
Christie, WW., 2003, Lipid Analysis: Isolation, Separation and Structural Analysis of Lipids. *J. Barnes and Associates*. 3: 205-225.
Mata, T.M., Martins, A.A., Caetano, N.S., 2010, Microalgae for Biodiesel Production and Other Applications: A Review, Renew. Sustainable Energy Rev., 14: 217-232.
Triantoro, K., 2008, Alga Mikro *Scenedesmus sp.* Sebagai Salah Satu Alternatif Bahan Baku Biodiesel di Indonesia, Karya Tulis Ilmiah, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Negeri Yogyakarta, Yogyakarta.



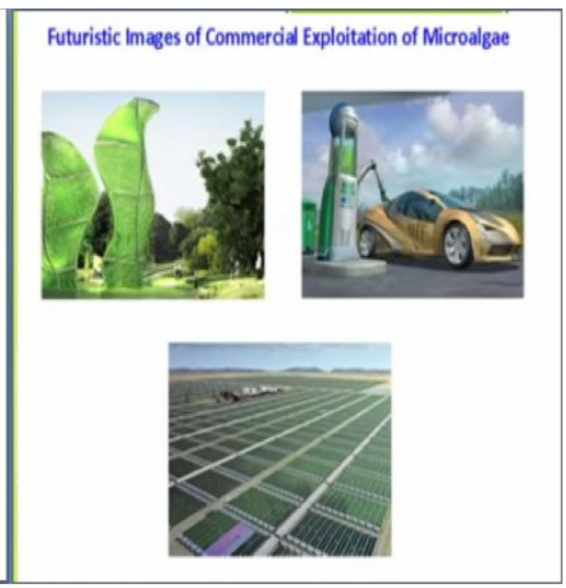








Parameter	Research Result	ASTM D6751 Standard
Free Fatty Acid Grade / FFA (%)	4,9912	≤ 0,4500
saponification number (mg KOH/g)	120,9161	≤ 500
Density	0,7858	≤ 0,90



PRACTICALITY ASSESSMENT DEVICE DEVELOPMENT OF LEARNING MODEL BASED METACOGNITIVE SKILL

Ijirana[1], Suyono[2], and Sri Poedjiastoeti[3]
[1]S3 Science Education, State University of Surabaya
[2,3]Department of Chemistry Education, State University of Surabaya
ijiranarizal@yahoo.co.id

ABSTRACT

Practicality assessment device is developed according to PBKM model which has been rated valid by the experts. The aim of the research is to gain the valid PBKM model of the practility assessment device. The device consists of observation sheet of the applied model syntax, unit of learning program, and student's worksheet. The valid score of the developed device is gained by giving the worksheet to five experts. The resultindicated that the whole evaluation aspects in the observation sheet of the applied model syntax which consist of direction to use the worksheet, the observation sheet content, and the used language gain the high score of validity. The validity of the whole evaluation aspects for the unit of learning program has been evaluated for high score by the experts, while the student's activity sheet has been evaluated varies between high and very high. The result indicated the experts stated that the practicality score sheet which is developed from PBKM model is well-used in the implementation of PBKM model.

Keywords : Practicality assessment, Syntax observation sheet, Unit of learning program, student's work sheet

INTRODUCTION

The describtion of learning model was determined by some experts such as ; Joyce, Weil and Calhoun (2011) stated that a learning model is the illustration of learning's environtment, which consists of the teacher's manner while the model wasconducted. Learning model had many utilies, starting from material and curriculum planning until instructional planning. Further, Arends (1997) stated that there were two reasons on why the term of model was used, namely: **first,** the model implied something which was wider than strategic, methode, or certain procedure in the learning. Therefore, the term of model had four specific characteristics which weren't owned by strategic or certain procedure, namely (1) theoritic rational which was arranged by its developer; (2) the basic idea about what would be reached in the learning and how student learned to reach the purpose; (3) teaching activity which was needed in order to make the learning model could be held successfully; and (4) the learning environtment which was needed in order to reach the desired purpose. **Second**, the model could be used as an important communication tool. Therefore, the learning model was classified according to its purpose, its syntax (its sequence pattern), and the environtment of learning.

According to the illustration above, a planned learning model which is purposed to develope problem solving skill and the concept's comprehension. It is arranged according to the theory of information processing, theory of Vygotsky's constructivist, and theory of metacognitive skill. Its syntax consists of five steps, they are orientation step, exploration, the application of metacognitive skill, self-reflection, and follow-up plan.The model is designed in a learning environtment and it's called learning model based metacognitive skill (PBKM model) (Ijirana, 2014). The model which is planned with four characteristics as it was explained by Arend (1997) must has good quality. According to Nieveen (2007), there are three criterias of quality, namely validity, practicality, and the effectivity of various kinds of design product in education including the learning model. A product is considered to be valid, if the design is based on the condition of knowledge scientifically (state-of-scientific knowledge) and there is consistency among design components which are developed internally. It is considered to be practical if the experts stated that the developed design was able to be applicated and it wasreally applicated in the field. It is considered to be efective if the experts stated that the learning design was effective and the appropriate result was given same as the expectation operationally based on their experiences.

The criteria of practicality which is meant can be obtained from the valid learning model through the development of learning device to evaluate the applied model. According to the idea of Nieveen (2007), so before it's used to evaluate the applied model, the device must obtain recommendation from the experts that the device is able to be applied. Therefore, in this research, the development of assessment device of PBKM model is held and validated by the experts in order to obtain a recommendation to be used in applying the model and fulfill one of criterias for a quality learning model. The problem is how about the worthiness of PBKM model's practicality assessment device product which is developed in order to be used in learning.

METHODE

This research is a development research, it developes practicality assessment device of PBKM model. The design of the research which is used is developed research design from Borg and Gall (1983) and sukmadinata (2012). Some used steps are : first, develope learning device according to PBKM model. One of developed devices is practicality assessment. Learning device which is used to evaluate the praticality of PBKM model is observation sheet in applying syntax. The implementation's planning of PBKM model syntax isscripted in lecture program unit and in applying the syntax using student activity sheet. Therefore, not only developing the observation sheet in applying syntax, but also developing the lecture program unit and student's activity sheet.

Second step, validate three devices which are developed by giving those devices with the evaluation sheet to five experts. These five experts are professional in science education. Third step, the evaluation result from the experts will be analyzed describtively to obtain the validity criteria andthe reability of device. The techinal of data analyzing which is used to determine validity and reabality of observation sheet in applying syntax, SAP, and LKM are as follows. (1) doing recapitulation for the evalution result of the experts into a table which consist of : aspect, indicator, and the validator's evaluation result. (2) counting the average of evaluation result for every evaluation aspect by dividing the score total which is given by validator for overall of the indicators in the evaluation aspect with the total of validators. (3) counting the average of the overall aspects by dividing the average total of the aspect with the total of the aspects. (4) determining validity category for every evaluation aspect or overall aspects by making the average of evaluation aspect or average of the overall aspects (RP) matching with the validity category. (5) the validity category of every assessment aspect or overall aspects for syntx application sheetis assigned based on the categories which are stated by Ratumanan & Laurens (2003) and Arikunto (2010) are as follows. $RP \leq 0,00$ (invalid), $0,00 < RP \leq 0,20$ (very low validity), $0,20 < RP \leq 0,40$ (low validity), $0,40 < RP \leq 0,60$ (enough validity), $0,60 < RP \leq 0,80$ (high validity), $0,80 < RP \leq 1,00$ (very high validity). (6) validity category of every assessment aspect or overall aspects for SAP and LKM is assigned based on these categories: $1 \leq RP < 2$ (invalid), $2 \leq RP < 3$ (enough validity), $3 \leq RP < 4$ (high validity), dan RP= 4 (very high validity). (7) reliability is calculated by using the formula of agreements percentage (Grinnell in Nurdin, 2007) withreliable criteria if its reability score (R) $\geq$ 0,70 (Abel, Springer & Kamata, 2009).

The criteria which is used to state that the learning device has a good validity degree, if the minimum of the achieved validity level is high validity. Furthermore, in the assessment sheet is also given recommendation coloumn which enable the experts to determine whether this device is able to be used, or it is able to be used with the improvement, or even it is unable to be used. If the achieved level is under valid and the experts recommend it's unable to be used (unworthy), so it needs to be revised according to the expert's correction and then conduct the revalidation. According to those steps for acquiring the assessment device has valid category. Moreover, even the experts give the valid assessment, but the recommendation which is given is able to be used with improvement,then the developed device remains to be improved without doing revalidation and it can used directly.

RESULT AND DISCUSSION

The Validaton Result of The Experts According To The Observation Sheet of PBKM Model's Applied Syntax

The assessment result of the expert for each aspect is summarized from the recapitulation of the expert's validity calculation which is included in Tabel 1. The table shows that all of the observated aspects in the observation sheet of PBKM model's applied syntax are valid asserted by the experts due to the average validity of three assessment aspects which are high categorized. If the assessment result of the overall aspects are observed, then the average of the overall assessment aspects are obtained 0,96 means that it's very high categorized according to Ratumanan & Laurens (2003) and Arikunto (2010). The fact indicates that the direction to fulfill the oservation sheet has been determined clearly, assessment's grains have been appropriated to the activity sequences of the lecture and student, and the used language's formulation is the easily-understood language. Therefore, the observation sheet is good and worthy categorized by the experts to be used for evaluating and observing the applied syntax of the PBKM's model

The Validity Analysis Result of the Applied Syntax Sheet of the PBKM model

Number.	Assessment Aspect	Assessment Average	Validity Criteria
1	Direction	1,00	Very High
2	Content	0,87	Very High
3	Language	1,00	Very High

In the assessment sheet, there are three validators state that the observation sheet of applied syntax of the PBKM model is "able to be used with improvement", two others recommend it's "able to be used" and no validator state that it's "unable to be used". It shows that the observation sheet of applied syntax of the PBKM model is able to be used with improvement.The improvement in the form of suggestion which is given by validator is classified into two kinds. First, the validator suggests that the lecture program unit is used for the instrument of observation. Second, problem solving sequences are better to be explained in the observation sheet clearly. According to the suggestion, the improvement is conducted by writting the programs which are done by the lecturer and student in observation sheet appropriate with the SAP scenario. Thus, overall, the observation sheet which is developed in this research is able to be used for evaluating the applied syntax of PBKM model.

The Validation Result of the Expert According to SAP of PBKM Model

Lecture program unit which is developed in teaching the main material of stoichiometry and chemical equilibrium includes six times of learning. There are 3 SAP which contain two times of meeting, namely meeting in class and meeting in laboratorium (practicum). The SAP draft of PBKM model is also validated by five experts through the assessment sheet. Analysis technic and validity determination as they have been explained in the part of research methode. The research result of the expert for each aspect is summarized from the recapitulation of the expert's validity calculation. It's included in Table 2.

Table 2 The SAP's Validity Analysis Result of PBKM Model

No	Assessment Aspect	The Average of Assessment Result to Each SAP and the Validity Criteria					
		1	2	3	4	5	6
1	SAP format	3,6	3,6	3,6	3,6	3,6	3,6
		High	high	high	high	high	high
2	Learning Program	3,7	3,5	3,6	3,4	3,6	3,6
		High	high	high	high	high	high
3	Language	3,3	3,3	3,3	3,3	3,3	3,3
		High	high	high	high	high	high

Datas in 2 show that all of assessment aspects of six SAP which are developed have high validity category. SAP validity criteria is used in this research, then those six SAPs are valid asserted by the expert and able to be used with some improvements.The result of calculation analysis for the six SAP's assessment aspects overall are rated between 3,44 until 3,51, it means that the SAP has a high validity category.The fact implies the SAP format, learning program, used language are appropriate with the validity criteria which is required in this research. Therefore, the developed SAP from PBKM model is able to be used as guidance in teaching the material to the chemical education students by using the learning sequences in the model of PBKM.

In assessment sheet which is given by validator, there are four people who give recommendation that this SAP "can be used with improvement", one person states this SAP "can be used", and no one state the developed SAP "can't be used".The decision implies that the developed SAP needs to be improved before it's used for learning. The improvement of SAP are : 1) managing the learning scenario from the side of sentence context in order to give an impression that in the learning process, the students are active and lecturer is facilitator and communicator only. 2) doing improvement to the some sentences in SAP based on the validator's suggestion to make the meaning and purpose clearly. 3) Writting time estimation that will be used in learning. 4) Writting the metacognitive activity which is done by students clearly in solving the problem for the part of learning scenario. According to the improvement result from the validator's suggestion, so the developed SAP is able to be used in the learning using PBKM model.

The Validation Result of the Expert According to LKM of PBKM Model

Same as the SAP draft, LKM draft of PBKM model also consists of six LKM which are validated by five experts through the assessment sheet.The analysis technic and validity determination also show the same. The assessment result of the expert for each aspect has been summarized from the recapitulation of the experts validity calculation which is included in Table 3.

Table 3 The LKM's Validity Analysis Result of PBKM Model

No	Assessment Aspect	The Average of Assessment Result For Each LKM and Validity Criteria					
		1	2	3	4	5	6
1	Organization dan content of LKM	3,5	3,6	3,6	3,6	3,5	3,6
		high	High	high	high	high	high
2	Language	3,8	3,4	3,4	4,0	4,0	4,0
		high	High	high	very high	very high	very high

Datas in Table 3 show that the assessment of six LKMs from the aspect of the organization and content, have high validity criteria. Then, the assessments of language's aspect obtain three LKMs which are high evaluated and three others of LKMs are very high evaluated. The result of calculation analysis for the overall of the six LKM's assessment aspect which are developed have been rated between 3,5 until 3,8. The rating means the validity criterias which are developed from PBKM model have high validity category. According to the validity criteria in this research, then all of LKMs which are developed from PBKM model are valid categorized by the experts and able to be used with some improvements. Therefore, this device can be used as the activity sheet for students in doing the tasks which are given during the learning of PBKM model.

There is also assessment sheet shows that from five experts who evaluate this LKM, four of them give recommendation for this LKM “can be used with improvement”, one of them states this LKM “can be used” and no one state it “can’t be used”. It gives direction that LKM which is developed from PBKM model needs to be improved before it’s used in learning. According to the suggestion which is given by the validator, the improvement which is going to be done is reanalyze the purpose that want to be reached in the explained tasks then adaptation and rearrange the used sentences to be more communicative. After the improvement has been done, so it is able to be stated that LKM which is developed and evaluated by the experts can be used in conducting the learning using PBKM model.

Beside the validity assessment, device’s reability analysis is also going to be done and the result obtains the practicality assessment device of PBKM model is reliable means that the device is worthy and reliably to be used for assessing the practicality/the application of PBKM model.

CONCLUSION AND SUGGESTION

Conclusion

1. Practicality assessment device of PBKM model has fulfilled the validity criterias and reability which are required. It’s seen from the assessment of the experts to the observation sheet of the SAP, LKM, and PBKM model’s applied syntax which are developed between high and very high validity category.
2. The assessment of worthiness from the experts generally state that practicality assessment device of PBKM model which is developed able to be used with improvement, so the device can be used after doing improvement without going through the revalidation process of the experts.

Suggestion

To obtain the learning model which is valid, practical, and effective, so the effectivity assessment device of PBKM model also needs to be validated by the experts before doing the trials of PBKM model and publishing the result.

REFERENCES

Abel, N., Springer, D.W., & Kamata, A. (2009). *Developing and Validating Rapid Assessment Instruments*. New York: Oxford University Press, Inc.

Arends, R. (1997). *Classrom Instructional and Management*. The Mc.Graw-Hill Companies, Inc: New York.

Arikunto, S. (2012). *Dasar-Dasar Evaluasi Pendidikan*. Edisi kedua. Jakarta: Bumi Aksara.

Borg, W. R. & Gall, M. D. (1983). *Educational Research (An Introduction*). Fourth Edition. New York & London: Longman Inc.

Ijirana. (2014) *The Design of Instruction Model Based On The Metacognitive Skill For Establishing Problem Solving Ability and Understanding of Chemical Con*cept. Proceeding International Conference on Mathematics, Science, Technology, Education and Their Applications. State University of Makassar.

Nieveen, N. (2007). Formative Evaluation in Educational Design Research. In Plomp, T. & Nieveen, N. (Eds.) *An Introduction to Educational Design Research.* Nederlands: Netzodruk, Enschede.

Nurdin. (2007). Model Pembelajaran Matematika yang Menumbuhkan Kemampuan Metakognitif untuk Menguasai Bahan Ajar. Disertasi Universitas Negeri Surabaya, Program Pasca Sarjana program studi pendidikan matematika.

Ratumanan, T.G., & Laurens, T., (2003). *Evaluasi Hasil Belajar*. Penerbit: Unesa University Press. Surabaya.

Sukmadinata, N. S. (2012). *Metode Penelitian Pendidikan*. Bandung: Remaja Rosdakarya

KNOWLEDGE HISTORY MAPPING OF STUDENTS OF PROSPECTIVE CHEMISTRY TEACHERS TO MOVE TACIT KNOWLEDGE TO ACCOUNTABLE EXPLICIT KNOWLEDGE

Kurroti A'yun

Study of Unesa Students of Prospective Chemistry Teachers

ABSTRACT

Students of prospective chemistry teacher need to be freed from misconceptions hidden in their tacit knowledge by moving it into explicit knowledge. Overcoming misconceptions is conducted by mapping their tacit knowledge through misconceptions detection test supported by assessment of learning styles. The combined tests aim to adjust the program for each student. Once their level and type of misconceptions are detected, the students are given misconceptions therapy by utilizing peer cooperation to fill in explicit knowledgemapping table. The mapping table is in accordance with method and practice of teaching adult learners (andragogy). Andragogy is used as underlying theory of teamwork in completing explicit knowledge mapping table because university students' learning motivation is different from that of school students'. University students are in transition to adult age who seeks knowledge not only for gaining knowledge but also for implementing it in life after college.

Keywords: misconceptions, tacit knowledge, explicit knowledge, andragogy, mapping table of explicit knowledge, motivation.

INTRODUCTION

a. Background

According to constructivist experts, misconceptions are naturally happen in learners' knowledge formation process. Knowledge is gained through continuous process of learning. The development of constructing knowledge in class rooms can be started from a very rough, simple and incomplete concept into a more complete, precise and correct, concept.

However, teachers must understand that students' brain are not like blank slate *(tabula rasa*) which is ready to be written in accordance with teachers' will (Redish, 1994). Teachers should be aware that there is sort of preconception in students' brain, therefore the task of teachers is to emphasize new concepts and to try to change the preconception which may be incorrect.

Knowledge is created from interaction of components of knowledge types. According to Nonaka (2004) and Polanyi (1979), there are two types of knowledge in human; they are tacit knowledge and explicit knowledge. According to Polanyi (1966), the characteristics of tacit knowledge are: 1) cannot be shared, 2) is more widely known than delivered, 3) often consists of habits and culture that cannot be determined, 4) cannot be codified, can only be moved or obtained from experience, 5) illustrates know what (facts) and know why (science), 6) involves learning and skill, 7) is formed in groups and organizational relationships, core values, assumptions, beliefs, difficult to identify, stored, calculated and mapped..

Explicit knowledge, according to Graff and Jones (1999), is tacit knowledge that has been documented and articulated in formal language that is easier to be transferred among people. Meanwhile, according to Nonaka and Takeuchi (1999), explicit knowledge is readily accessible knowledge, documented in formal source of knowledge that has been organized well. Explicit knowledge is concluded as knowledge derived from tacit knowledge that has been articulated, documented, codified, organized in particular media for example with IT support that it can be easily accessed and distributed to those in need.

Misconceptions in tacit knowledge can be overcome with the support of explicit knowledge through some ways according to a person's type in absorbing new knowledge. The weakness of tacitknowledge, which is difficult be developed and deployed that it is difficult to be source of knowledge that creates new valuable and applicable idea, is necessary to be acknowledged. Effort is necessary to transfer tacit knowledge into explicit knowledge to enable students to receive meaningful knowledge within their selves.

Mapping of knowledge history is necessary to measure the extent a person's tacit knowledge before replaced by explicit knowledge. A research conducted by Suyono (2014) showed that the structure of students' initial conception in the class was made up of students with potential of not knowing concept as the largest proportion, followed by students with potential of misconceptions and students with potential of knowing concept. After prevention stage and at the end of remediation either in implementation and dissemination level of research classes, each learning package still leaves student with misconceptions.

Human knowledge is obtained from a process of reasoning, which is a process of thinking in drawing a conclusion in the form of knowledge. This reasoning produces knowledge associated with activity of thinking and not by feeling. Nevertheless, not all thinking activities rely on reasoning. Knowledge generated from reasoning possess basis of truth if the thinking process is performed in a certain way. This paper offers a way to generate knowledge based on reasoning with foundation of knowledge truth or accountable knowledge by mapping knowledge history from knowledge acquisition of tacit knowledge into explicit knowledge to the students of students of prospective chemistry teachers.

Students of prospective chemistry teacher were chosen as subject to implement the program of overcoming misconceptions based on the following empirical arguments. First, findings of six researchers (postgraduate students) under a research conducted by Suyono (2014), they were Muallifah (2013), Ahmad (2013), Subagyo (2014), Hastuti (2014), and Hono (2014). All of them reported school students' statement that the cause of chemistry misconceptions that burdened them was learning by their chemistry teachers. Second, Kolomuc and Tekin (2011) found evidence that teachers had misconceptions on the concept of chemical reaction rates. Third, Lemma (2013) found a significant correlation between intensity of chemistry misconceptionss in students and the teacher with discrimination index value of 90%. That means students misconceptions was 90% caused by teachers misconceptions, while 10% was due to other factors.

Considering that prospective chemistry teachers were the research object, the learning program for overcoming misconceptions is adjusted for prospective teachers' nature of learning, which is andragogy (learning for adults) rather than pedagogy (learning for children) (Pew, 2007).

According to Knowles (1975), adults are often quick result oriented with short learning period. Therefore, a learning program is set as effective as possible and as efficient as possible by utilizing the mapping of tacit knowledge with misconceptions in it in the form of misconceptions detection and learning styles test. After the test is conducted, healing therapy for misconceptions is given by listing the correct concept by utilizing teamwork and various types of activities in learning. The result is then summarized in correct concept mapping table. (Giamellaro *et al.*, 2011)

b. Knowledge and Learning

The realization that learning is a process of becoming person and not a process of being hopedbrings awareness that learning activities should involve individual or client in the process of thinking: what they want, what is done, determine, plan and perform any actions necessary to meet the desire. The essence of education is to help people to learn how to think for themselves, organize their own lives to grow and mature, taking into account that they are also social beings.

Knowledge begins with curiosity, certainty begins with hesitation and philosophy begins with both. Philosophizing is encouraged to know what we have known and what we hve not known. Suriasumantri (2009) stated that that philosophizing means being humble that not everything we will know in seemingly limitless universality. A person can absorb knowledge properly if he/she also understands philosophy.

Person gains knowledge by entering information, store it, and process it in a conscious or unconscious condition with reasoning. Reasoning is a process of thinking in drawing a conclusion in the form of knowledge. Reasoning produces knowledge associated with thinking activity and not by feeling, yet not all thinking activities rely on reasoning. Usually, students enjoy learning activities for two main things, first, teachers are able to present varied learning methodologies that are relevant and contextual, second, teachers have high competence in mastering teaching materials.(Suyono, 2015).

Knowledge processed based on scientific method is knowledge that meets the requirements of science and can be called scientific knowledge or science. In essence, scientific knowledge has three functions of explaining, planning and controlling. Structure of Scientific Knowledge:

1. Theory is scientific knowledge that includes explanation of particular factor of a scientific discipline.
2. Laws are statements that express the relationship between two or more variables in a causal link.

3. Principle is statement that applies generally to a group of specific symptoms that are able to explain the events that occur.
4. Postulate is basic assumption whose truth we receive without proof required.
5. Krogh, Ichiyo, and Nonaka (2000) conveyed idea of understanding of knowledge: (1) knowledge is justified true believe*;* (2) knowledge is something that explicit and tacit (3) the creation of knowledge effectively depends on the context that enables the creation; (4) the creation of knowledge involves five main steps, they are 1. Sharing tacit knowledge*;* 2. Creating concept, 3. Justifying concept; 4. Building a prototype; and 5. Disseminating knowledge.

Suyono and Hariyanto, (2015) stated that there are three important aspects in learning, namely pedagogy, didactic and methodic. However, in fact, every individual has awareness that learning is a process of becoming person and not a process of being hoped according to others will brings awareness that learning activities should involve individual or client in the process of thinking: what they want, what is done, determine, plan and perform any actions necessary to fulfill that desire. The essence of education is to help people learn how to think for themselves, organize their own lives to grow and mature, taking into account that they are also social beings.

According to Knowles, (1975; 1979), learning is divided into two: to students of younger age (children and adolescents) or known as pedagogy and learning for adult learners, i.e. 18 years and over, known as andragogy. Adult learning theory (andragogy) is more inclined to psychology to organize self in analyzing the sources of learning that comes from experience that should be develop to immediately applied to become a meaningful learning.

University student who have reached the age of early adulthood should be given a adult-oriented learning (andragogy) for they have more learning experience than school-aged children. Moreover, teacher education students will have duty to teach students; therefore, they should be more creative and understand science they will teach to students.

Pew (2007) asserted that most suitable method for university students level is andragogy, not pedagogy. Andragogi is more suitable for university students for they have more experience than school age. For students of teacher education, they are prospective teachers who are demanded to be more mature than their school students are, and more insightful in motivating them to learn.

c. Concept and Misconceptions

Concept is a mental integration of two or more units of reality aspects (entity, properties, events, quality, relationships, and so on) isolated according to characteristics and combined with typical definition (Rand, 2003). Isolating activities involved is a process of abstraction, mental focus that selectively removes or separates certain aspects of reality from others. Unification process involved is not merely addition, yet integration, which is integration of units into new mental entities and new knowledge obtained from beyond knowledge buried within oneself (tacit knowledge), but move towards explicit knowledge (Polanyi , 1979).

Nakhleh (1992) defines concept as a set of propositions that serves to sense a particular topic. Concept consists of simple interrelated declarative statement (proposition) that describes students' building about a concept. For example, concept of the atomic nucleus is composed of propositions: each atom has a core, in the nucleus are protons and neutrons, the atomic mass is concentrated in the core, and so on.

Misconceptions are associated with concept. According to Abraham (2012) misconceptions is wrong idea about a concept owned by a person which is different from concept which is agreed and considered true to researchers. Usually this different (false) view is resistant and persistent. Suparno (2005) argued that misconceptions term has another term, which is alternative concept. Alternative concept is defined as concept that is incompatible with concept recognized by experts. Both opinions agree that misconceptions is a problem on a person regarding mistake in understanding a concept, that different alternative concept which is different from experts' concept.

Philosophically, students' misconceptions can be explained by constructivism, philosophy of learning. Constructivism briefly states that knowledge is formed (constructed) by the students themselves in contact with environment, challenges, and the materials being studied. Because knowledge is the students' knowledge construction (surely with the help of teacher/educator/lecturer), then it can happen, although given the same material or subject matter, different student builds knowledge from the teachers' goal. Suparno (2005) asserted that there are five factors causing misconceptions, they are students, teachers, textbooks, context and methods of teaching.

DISCUSSION

a. Misconceptions Detection and Learning Styles Test

Misconceptions can be detected or diagnosed in some ways, one of which is three-tier diagnostic test. This test was developed by Eryilmaz and Surmeli in 2002 from two-tier diagnostic test. Two-tier diagnostic test was developed for it was less reassuring to less able to distinguish between misconceptions and not knowing concept (Hasan et al. in Pesman and Erylmas, 2010). With three-tier method of diagnostic test, students do not only rely on their assurance but also strengthen their assurance in answering questions for it needs alternative reasons. Those reasons consist of correct answers and distracters, which sometimes researchers provide a special place for alternative reasons. Thus, two tier diagnostic test was developed into three levels by adding level of confidence on the third level in the form of confidence rating (CR) to measure the level of students' assurance toward their answer.

Below is an example of the misconceptions detection test used in this study design.

Table 1. Misconceptions Detection Test by Using Three-tier Diagnostic Test

No.	**Indicator**	**Types of Concept**	**Question items**	**Key**		**Construction**				
				Ans	Reason	1	2	3	4	5
23.	Choosing non-example	Non electrolytes	Which of the following compounds belong to non-electrolyte? a. NaOH							

			b. $(NH_2)_2CO$ c. C_2H_5OH d. $Ba(OH)_2$ **Choose one reason that correspond to your answer!** 1. Soda 2. Urea 3. Soap 4. Alcohol **Are you sure about your answer for the previous two questions?** a. Yes, I am sure b. No, I am not sure							

According to Woolfolk, (2009), Learning style is a person's typical way of approaching learning (learning about something specific things) and studying(learn generally). Pritchard (2009) described learning styles are (1) a certain way someone does when learning, (2) a person's best ways has when thinking, processing information, and explaining information obtained, (3) a person's tendency to gain knowledge and skills.

Each student possesses different learning styles. Teachers also have different teaching styles. This is shown in Table 2.

Table 2. Dimensions of Learning and Teaching Styles

Preferred Learning Style		*Corresponding Teaching Style*	
sensory intuitive	perception	concrete abstract	content
visual auditory	input	visual verbal	presentation
inductive deductive	organization	inductive deductive	organization
active reflective	processing	active passive	student participation
sequential global	understanding	sequential global	perspective

Source: Felder & Silverman (1988)

In the process of learning, teacher transfer their knowledge to students. In this process, when teachers' teaching styles match the students' styles, students tend to pay attention, otherwise the students tend to ignore (Felder, 1993).

Chemistry learning associated with science process skills makes learning meaningful and easily stored in students' long-term memory. According to Dale's Cone Experiment, 90% information is stored in students' mind because the learning is based on personal experience/personal action/students actively perform an action/involved during the learning process (learning by doing).

Therefore, the most appropriate learning program to make sure that teachers are ready to teach without any misconceptions that may be transmitted to the students is to combine effective work to grow personal experience. Students of Chemistry teacher education are also introduced to complete and in-depth chemical characteristics based on science as generator by teaching chemistry concepts based on concept analysis one of which was made by Herron, (1977).

Concept analysis can be modified, combined with curriculum mapping (Giamellaro, 2011) to overcome teachers and prospective teachers, particularly chemistry teacher. The modification is named by the writer as Mapping of Knowledge Profile to ExplicitKnowledge (see Table 3). Implementation of Dale's Cone Experiment can be implemented by this mapping of knowledge history, because mapping of knowledge history is carried out in groups and involves learning by doing activities of each member of the group. (Dale, 1969; Anderson, Fadel, 2008). Studying in groups can avoid rigidity of learning process. Theory of andragogy (learning for adults), which is the development of pedagogy learning theory (learning for children) is used for chemistry prospective teachers as adjustment with their age based on Knowles' statement (1979).

Below is a graph of completeness required in learning process that must be fulfilled by teachers in implementing pedagogical tasks, taking into account of didactic.

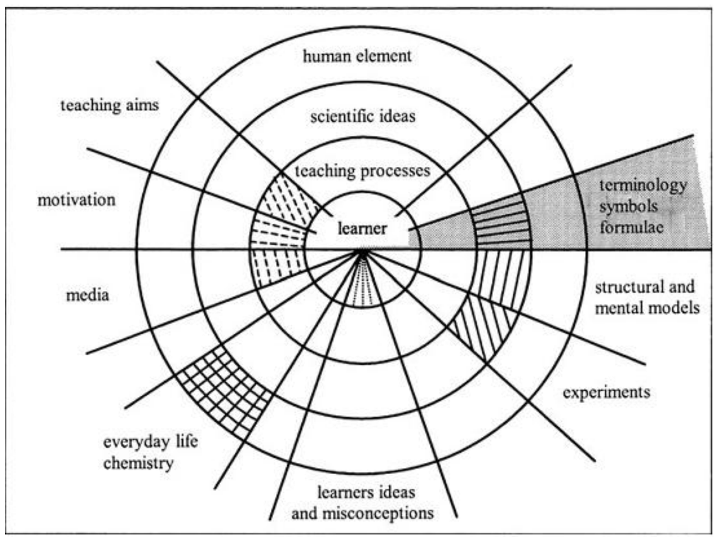


Figure 1. Graph of Didactic Structure in Learning Chemistry (Dietter, 2012)

Giamellaro *et al.*, (2011) provided an example of curriculum mapping in his research to overcome misconceptions in junior high school chemistry teacher in the following figure.

Lesson	Length *(class sessions)*	Learning Target	Declarative Knowledge	Procedural Knowledge	Schematic Knowledge	Activities	Documentation	Critical Graphical Representations	Materials	Vocabulary	Concerns/ Comments
7	Sessions 1 & 2	Students will be able to verbalize that the rate of evaporation of liquids depends on the amount of heat that is added and the type of liquid	When liquids evaporate, they don't disappear. They change state to gas. Students will recognize that liquids other than water can change states	Students will practice scientific methods They will make hypotheses They will be introduced to the use of controls and variables in experiments. Students will keep accurate measurement of time.	Heat energy causes matter to change states	1. Class discussion on what happens to puddles and where liquid goes when it "dries up". Students will talk about the process of evaporation and what vapor means. 2. Groups complete experiment activity: equal amounts of water & alcohol are dropped onto a paper towel. The samples tested are placed at two stations that vary in heat. Students measure the temperature & record the amount of time it takes for the samples to evaporate at each station. 3. Students calculate elapsed time. 4. Entire class discusses team results and observations.	Data Table BLM 7-1 upon which is recorded start, stop, elapsed time, and temperature for both liquids at two stations.	Student Guide p. 71	Thermo-meters Eye droppers Paper Towels Journals BLM 7-1?	Control Variable Rubbing alcohol Hypothesis Frayer Model-optional Vapor	This is an opportunity to discuss variables and controls. This is not explicit and will only occur if the teacher takes the initiative to do so. Also, reading and calculating elapsed time is challenging and time consuming for the students. There almost needs to be a mini-lesson on reading clocks and subtracting time to make this accessible for all students.

Figure 1. Examples of Curriculum Mapping to overcome misconceptions on Junior High School Chemistry Teacher

Furthermore, a little modification was done to map knowledge history by collaborating it with misconceptions and learning styles test. Below is the mapping correct knowledge history (towards explicit knowledge).

Table 1. Tabulation example of Correct Knowledge History Mapping (ToExplicit Knowledge)

Learning materials	Learning Target		Types of Knowledge			Activity	Documentation	Critical statements with Graphics	Necessary tools	Vocabulary Required or Used
	Scientific knowledge	Scientific practice	Declarative	Procedural	Schematic					

Below is the example of filling the explicit knowledge

Learnin g material s	Learning Target		Types of Knowledge			Activity	Documenta tion	Critical statements with Graphics	Necessary tools	Vocabulary Required or Used
	Scientific knowledge	Scientific practice	Declarative	Procedural	Schematic					
Solution	Able to define and determine examples and non-examples of solution	Testing the materials mixed that it becomes solution	Definition of solution, which is a mixture of homogeneous particle size <1nm Examples of solution are:	Hypothesizing about solution, e.g syrup powder mixed with water is true solution, milk powder mixed with	Showing solution scheme	Class discussion about solution activities occurred during the experiment Students analyze	Data in the form of table or photograph of experiment result containing the type of materials	Module or chemistry textbooks of solution	Various materials for experimental solutions, such as: Glass Mixer Powder syrup	Variables Control

			sugar water, gas mixture of O_2 with H_2S gas, etc. Non solution examples are: mixing milk with water, fog in the morning	water is not real solution preparing materials and instruments of the experiment testing the solution Summing up the results of the experiment		changes in materials mixed Class discussion about the results experiment on solution	and the type solution result.		Milk powder Supporting pictures Supporting Videos	

Curriculum = lesson plan = elaboration of learning activities

Comments related to the solution:

1. The solution may come from liquid or solid matter or gases

2. The solution is a homogeneous mixture with a size > 1nm

3. ....

Table of knowledge history mapping above is suitable for students who are no longer in school age, yet have stepped up and prepared to be teachers who will teach the materials. Table of knowledge history mapping above is more suitable or appropriate to adult learning (andragogy), for way university students' way of thinking is no longer operational- concrete, rather, in stage of formal operational that they can think of hypotheses, critical, reflective and constructive. University students' learning objectives are also generally more pronounced of preparing to enter the workforce, or develop career in accordance with their potential, talents and interests. Past learning experience present life experiences (tacit knowledge) are also more visible participate and influence the learning activities taken. Semiawan (1999) suggested that if universities want to bring a renewal of life in the community, their learning strategies must be creative in order to create independent students and students who understand their own integrity.

Andragogy assumes that adults learn more effectively when needs are identified and met. Knowles (1980) asserted that there are two types of learner needs, personal needs and educational needs. Personal needs are:

1. Physical needs - sight, hearing, comfort, adequate rest, and so on.

2. Growth needs (needs to thrive)- knowledge development, understanding, skills, attitudes, etc.

CONCLUSION

Program of overcoming Chemistry misconceptions on students is more effective by implementing it to teacher in advance, in this case is earlier for students of prospective teachers.

By equipping students of chemistry prospective teachers without misconceptions, school students are expected to be also free of misconceptions. This debriefing involves learning theory for adults (andragogy), for students of prospective teachers are human figures expected to guide their students after graduating from college.

BIBLIOGRAPHY

Barke, Hans-Dietter; Harsch, Gunter; Schmid, Siegebert. 2012. *Essential of Chemical Education*. Berlin: Springer-Verlag Heidelberg

Dale, Edgar. 1969. *Audio-Visual Methods in Teaching*. New York: Dryden.

Fadel, Charles. 2008. *Multimodal Learning Through Media: What The Research Says*. Cisco Systems USA: Cisco Public Information.

Giamellaro, Michael; Lan, Ming-Chi; Ruiz-Primo, Maria Araceli, and Li, Min, 2011. *Addressing Elementary Teacher Misconceptions in Science and Supporting Peer Learning Through Curriculum Mapping*. Seattle: University of Washington.

Hastuti, Wahyu Juli. 2013. *Prevensi Miskonsepsi Siswa pada Konsep Reaksi Redoks Menggunakan Model Modified Inquiry dan Remediasi Menggunakan Strategi ECIRR*. Makalah. Pascasarjana Unesa.

Hono, Agus Sri. 2013. *Prevensi Miskonsepsi Siswa pada Konsep Reaksi Redoks Menggunakan ModelLearning Cycle 7E (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend) dan Remediasi Menggunakan Strategi ECIRR*. Makalah. Pascasarjana Unesa.

Ibrahim, Muslimin. 2012. *Konsep Miskonsepsi dan Cara Mengatasinya*. Surabaya: Unesa University Press.

Knowles, Malcolm S. 1975. *Adult Education: New Dimension*. Raleigh: North Caroline State University.

Knowles, Malcolm S. 1979. *The Modern Practice Of Adult Education*. Prentice Hall Regents, Englewood Cliffs: Cambridge Adult Education.

Knowles, Malcom S. 1980. *The Modern Prcatice of Adult Education: From Pedagogy to Andragogy*. N.Y.: Cambridge, The Adult Education Company.

Kolomuc, Ali & Tekin, Seher. 2011. Chemistry Teachers' Misconception Concerning Concept of Chemical Reaction Rate. *Eurasian J. Phys. Chem. Educ*, 3(2), 84-101.

Lemma, Abayneh. 2013. *A Diagnostic Asessment of Eighth Grade and Their Teachers' Misconceptions About Basic Chemical Concepts*. *AUCE*, 3(1), 39-59.

Muallifah, Lilik. 2013. *Prevensi dan Reduksimiskonsepsi Kesetimbangan KimiaSiswa SMA Negeri 1 Kandangan Kediri*. Tesis. Pascasarjana Unesa Surabaya.

Nakhleh, Mary. 1992. *Why Some Students Don't Learn Chemistry*. Journal of Chemical Education. 3(69).

Pesman, H., and Eryilmaz, A. 2010. *Development of a Three-Tier Test to Assess Misconceptions About Simple Electric Circuits*. Turkey: The Journal of Educational Research, 103, 208-222.

Pew, Stephen. 2007. *Andragogy and Pedagogy as Foundational Theory for Student Motivation in Higher Education*. Texas: Park University.

Polanyi. 1979. *The International Encyclopedia of the Special Sciences*. vol. 18 Chicago: University of Chicago Press.

Pritchard, Alan. 2009. *Ways of Learning: Learning theories and learning styles in the classroom*. Second edition. Abingdon: Routledge.

Rand, Ayn. (2003). *Pengantar Epistemologi Objektif*. Yogyakarta: Bentang Budaya.

Redish, Edward F. 1994. *Implications of Cognitive Studies for Teaching Physics*. American Journal of Physics, 62(9) 796-803.

Subagyo, Imam Arif. 2013. *Prevensi Miskonsepsi Siswa pada Konsep Kesetimbangan Kimia Menggunakan Modified Inquiry dan Remediasi Menggunakan Strategi Analogi.* Makalah. Pascasarjana Unesa.

Suparno, Paul. 2005. *Miskonsepsi dan Perubahan Konsep dalam* Pendidikan. *Fisika.* Jakarta : Grasindo

Suriasumantri, Jujun S. 2009. Filsafat Ilmu: Sebuah Pengantar Populer. Jakarta: Pustaka Sinar Harapan.

Suyono, Amaria, Muchlis dan Setiarso, Pirim. 2013. *Diseminasi Model Prevensi dan Kurasi Miskonsepsi Siswa pada Konsep Kimia.* Laporan Hasil Penelitian Unggulan Perguruan Tinggi (tidak dipublikasikan). Surabaya: Lembaga Penelitian.

Suyono dan Hariyanto. 2011. *Belajar dan Pembelajaran Teori dan Konsep Dasar*. Bandung: PT Remaja Rosda.

Suyono dan Hariyanto. 2015. *Implementasi Belajar dan Pembelajaran*. Bandung: PT Remaja Rosda.

Suyono, (2014). *Preparasi Sarjana Pendidikan Kimia Tanpa Miskonsepsi Di FMIPA UNESA.* Pendidikan Kimia Universitas Negeri Surabaya.

Woolfolk, Anita. 2009. *Educational Psychology Active Learning Edition*. Yogyakarta: Pustaka Siswa.

A REVIEW ON ANTIPYRETICS AND THE SYNTHESIS ON THE OXEPINE DERIVATIVES

Nurul Kasyfita

ABSTRACT

A review on antipyretics and the synthesis on the oxepine derivatives has been done. This research was aimed as the early review on the antipyretics and to synthesis the oxepine derivatives from salicylic acid and benzylchloride based on the retrosynthesis approach. This research was supervised by Dr. K.M Lokanatha Rai, M.Sc in the University of Mysore.

This research was done by two methods, first is the review based on the proposed functional group which will be potential for the antipyretics substance. Second, is based on the retrosynthesis approach in order to obtain the proposed product through the condensation reaction between salycilic acid and the benzylchloride with the THF solvents stirred of 48 hours formed the oxepine which was then transformed to oxime derivatives and confirmed by the IR spectrums. The proposed product was the oxepine derivatives.

The review on the antipyretics showing that the potential functional group to be the antipyretics are: the salicyl alchol nitrogen derivatives; some pyrazolone and amino pyrimidine; benzopyranone derivatives; and aspirin eugenol esters. For this review, the investigated functional groups are still further to be discussed.

The result of this research on the synthesis of oxepine derivatives shown that the optimum condition of the reaction between salicylic acid and benzyl chloride is at room temperature with the composition of 4 gram of salicylic acid and 4 ml of benzyl chloride was stirred in THF solvent and KOH for 48 hours. The yield of the product is 1.08 g with the confirmed spectrum of IR are: 3369 cm^{-1} (-OH); 1659.4 cm^{-1} (C=N); 1554.92 cm^{-1} (aromatic); 1088.3 cm^{-1} (N-O); 1019.83 cm^{-1} (C-O). It is confirmed as an oxime which is the oxepine derivatives.

Keywords: antipyretics, oxepine, synthesis.

A. Background

Human beings, since old ages have used various substances to lower body temperature. Applying *Peruvian cinchona* bark as an antipyretic dates to the early 1600s, but by the 18th century overharvesting of cinchona created scarcity and a search for substitutes begins.

In 1763, Reverend Stone reported to the Royal Society of London on the antipyretic effects of “fever bark” from English willow. Although his finding appeared novel, it simply confirmed what was known to Hippocrates, Galen, and ancient Egyptians centuries before.

Salicylic acid was first prepared in 1838 from the glucoside salicin[1], the active component in willow bark. Another derivative, acetylsalicylic acid (aspirin) was later synthesized in 1853 and made commercially available as an antipyretic in 1899. Since then, numerous antipyretics have been introduced into clinical medicine.

The principal action of antipyretics rests in their ability to inhibit the enzyme cyclooxygenase (COX) and interrupt the synthesis of inflammatory prostaglandins. Recent studies on the mechanism of antipyretic action of these drugs, however, reveal effects independent of COX inhibition as well[1].

Many researchers in the field of medicinal chemistry are trying to invent new drugs which have antipyretic activity. The use of Non Steroidal Anti-inflammatory Drugs (NSAIDs) which endangers health on long term use, makes many scientists to compete with each other to synthesize and obtain products which may have antipyretics activity[8].

Some of the functional groups which may have the antipyretic activity are as follows: (1) Salicyl alcohol nitrogen containing derivatives; (2) Various substituted pyrimidines, pyrazolones and their Schiff bases; (3) Derivatives of benzopyranone; (4) Terpene sulfide of the menthane series; (5) Aspirin eugenol ester.

The salicyl alcohol nitrogen containing derivatives *which are* [4-(2-hydroxybenzyl) morpholin-4-iumchloride (I)], [1,4-bis (2-hydroxybenzyl) piperazine-1,4-diium chloride [II)] are also found to be potential antipyretic agents. This study even has investigated the mechanism of the synthesized compound by molecular docking and dynamic simulation studies to mimic the binding movement of the drugs molecule with COX-2 inhibitors. They prove that these compounds show antipyretic activities[9].

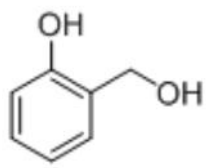
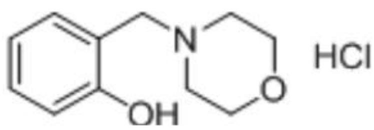
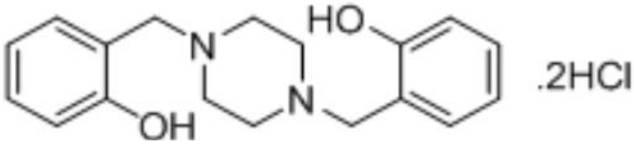


Fig. 1. Basic Compund of Antipyretics

Using the above basic compound, two types of compounds containing derivatives attached to morpholine and piperazine were synthesized. Their structures are given below.



Compound I [4-(2-hydroxybenzyl) morpholin-4-ium chloride].



Compound II [1,4-bis (2-hydroxybenzyl) piperazine-1,4-diium chloride]

Fig. 2. Some synthesized compunds having superior antipyretic activity

The combined favorable interactions based on dipole-dipole interactions and hydrogen bonding could be the major reason behind its experimental effect on inflammation and peripheral pain. The elongated yet flexible skeleton of compound II [1,4-bis (2-hydroxybenzyl) piperazine-1,4-diium chloride] showed considerable molecular interactions with the main binding pocket of the enzyme. Phenolic groups at both ends of the compound II revealed to have a major role in the strong binding affinity for COX-2. On outside of the binding pocket, the phenolic group was shown to have the same role as played by the carboxylic moiety of co-crystallized flurbiprofen. Phenolic group was anchored to both Arg120 and Tyr355 via hydrogen bonding interactions at 2.468°A and 2.75°A, respectively. On the other hand, the second phenolic group was strongly held by the O (oxygen) of Met522 using hydrogen bonding at a distance of 2.60°A. However, piperazine ring played the role of a spacer group without showing any polar interactions. Molecular docking simulation studies have revealed that there exists special hydrogen bonding interactions with the amino acid residue of COX-2, like Arg120 and Tyr355, thus implicating prostaglandin pathway with COX activity [10]. So, in these compounds, basically the bonding interaction between the drugs and the COX are from **phenolic group** which gives rise to the special hydrogen bonding interactions.

Based on this novel review of antipyretics, the research on the synthesis from salicylic acid combined with benzyl chloride will be very interesting to be investigated. Other than that, the optimum of reaction which gives the highest yield will be the other field of investigation.

B. Method

This research was performed by giving reaction between the salicylic acid and the benzyl chloride with various comparison of composition. The experiment will be on the determination of the best condition to give the highest yield and to confirm the formed compound by the suitable instrument.

About 4 gram of salicylic acid is mixed with 2 gram of KOH pellets and 20 ml of THF as the solvents followed by 4 ml of benzyl chloride. This solution is then stirred with magnetic stirrer and monitored by the use of TLC to ensure the proposed product has been formed. The formed product was then washed with $NaHCO_3$ repeatedly until there was no trace of the contaminant or the residue of the starting material. The TLC plate was monitored using the solvent system of ethyl acetate of 20% in the petroleum ether (1:5).

The organic layer was then dried using Na_2SO_4 and was evaporated to get the crude product of the orange-yellow color. Since it was showing the trace of benzyl chloride, it was then converted into the oxime as the oxipne derivatives. The formed product was then confirmed by the use of IR spectroscopy by investigating the formed peak. The obtained yield is 1.06 gram or 26.5% as the yield percentage.

C. Result and Discussion

The research goal is to obtain the oxepine derivatives based on the reaction between salicylic acid and benzyl chloride in room temperature. The reaction is as follows:

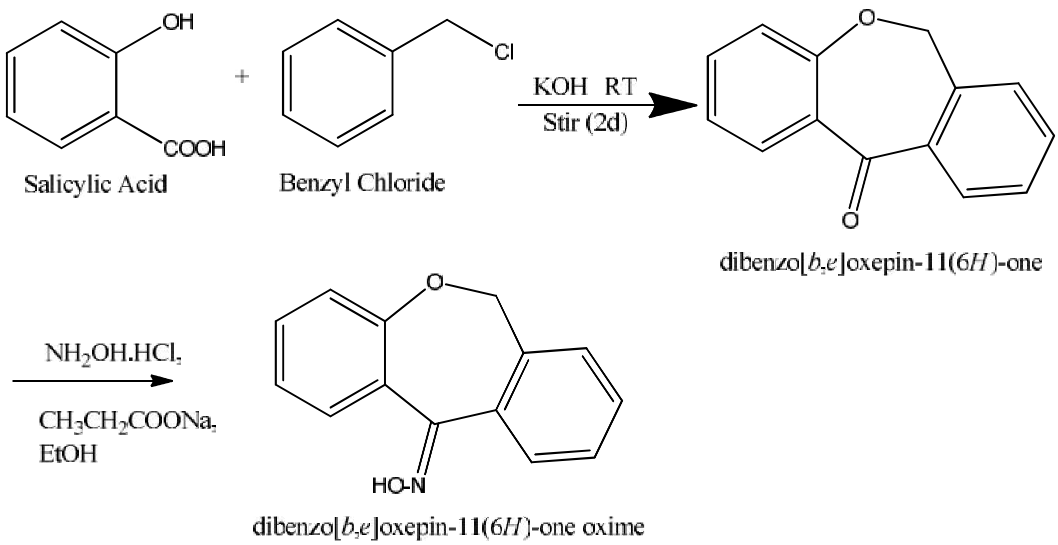


Fig.3. Reaction of Salicylic Acid and Benzyl Chloride

The product is then analysed by Infra Red instrument to obtain the peak assigning for the particular functional groups. It is known as an oxime derivatives which has –OH group, C=N group, aromatic group and C-O group. It is partially soluble in DMSO and chloroform, and completely soluble in ethanol and acetone.

The reaction mechanism is given as follows:

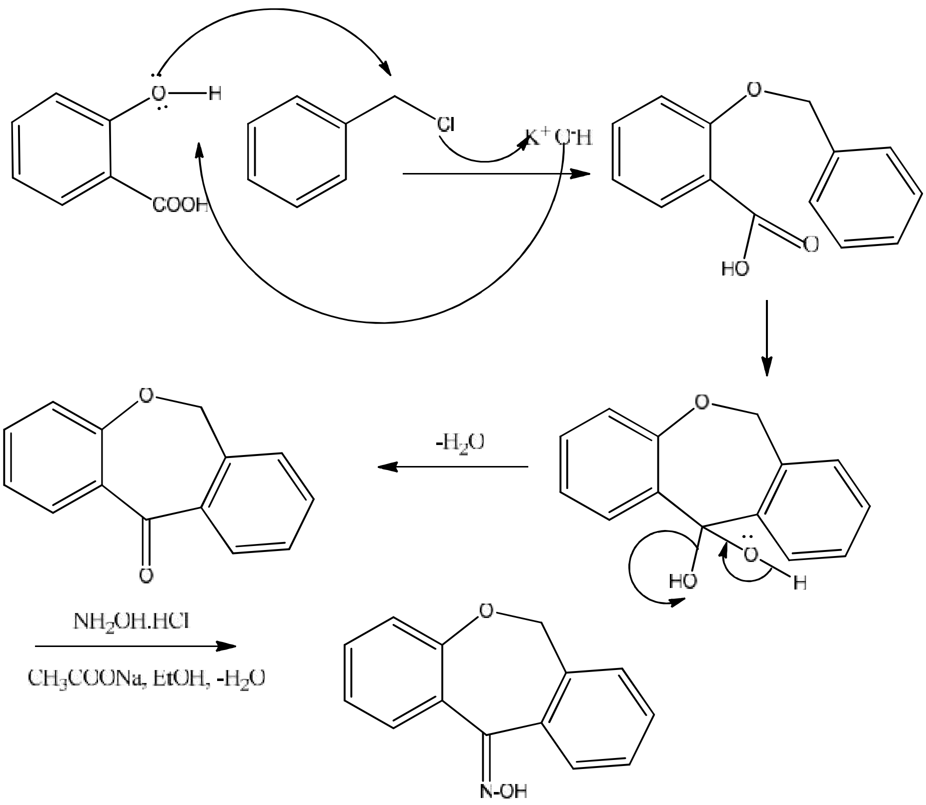


Fig. 4.2 Reaction Mechanism

The Infra Red spectrum is given on the following page. It is known from the peak based on the spectrum obtained by the instrument of Perkin Elmer Spectrum Version of 10.03.09 on May 12th 2014, it is assigned that the product has:

1. O-H group at the peak of 3369 cm^{-1}
2. C=N group at the peak of 1659.4 cm^{-1}
3. Aromatic hydrocarbon at the peak of 1554.92 cm^{-1}.
4. N-O group at the peak of 1088.3 cm^{-1}, and
5. C-O group at the peak of 1019.83 cm^{-1}.

Thus, the product is the oxime derivatives.

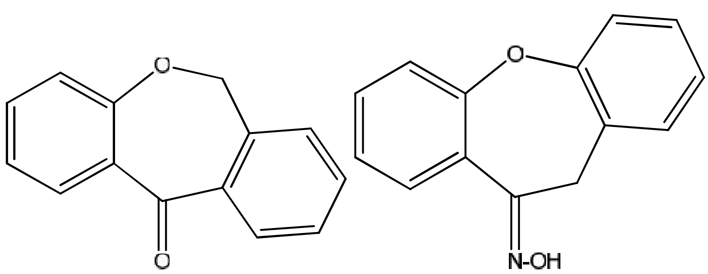


Fig. 4. Structure of Oxepine and Oxime Derivatives

D. Conclusion

Based on the research result, the conclusions are: (1) some of the potential functional group to be the antipyretics are: the salicyl alchol nitrogen derivatives; some pyrazolone and amino pyrimidine; benzopyranone derivatives; and aspirin eugenol esters; (2) The yield of the oxepine derivatives is 1.06 g from the 4 g of salicylic acid and 4 ml of benzylchloride; (3) The product was confirmed as oxime, the oxepine derivatives with the IR spectrums are as follows: 3369 cm^{-1} (-OH); 1659.4 cm^{-1} (C=N); 1554.92 cm^{-1} (aromatic); 1088.3 cm^{-1} (N-O); 1019.83 cm^{-1} (C-O).

E. References

Aronoff, David, M., Neilson, G, Eric. *Antipyretics, mechanism of action and fever suppression. The American Journal of Medicine. 2009, 111 (4),* **304-315.**

Kauffman, Ralph; Sawyer., L.A., Scheinbaum, M.L., *Antipyretics Efficiency of Ibuprofen Vs Acetaminophen. American Journal of Dis Child, 1992, 146 (5),* **622-625.**

Gordon and Breach. *Aspirin History: Organic Molecules in Action.* Goodman and Morehouse Publishers, 1973, **325-337.**

Mackowiak PA*Brief History of Antipyretic Therapy. Clinic Infect Dis. 31 (Supplement 5), 2000.* **154-156.**

Ghosh, Shoma, et. al. *Bioactivity Guided Isolation of Antiinflammatory, Analgesic, and Antipyretics Constituents from the Leaves of Pedhilanthus tithymaloides (l). Medicinal Chemistry Research. 22, 2013,* **4347-4359.**

Ali, Gowhar, et, al., *Pharmacological Evaluation, Molecular Docking and Dynamic Simulation Studies of Salicyl Alcohol Nitrogen Containing Derivatives. African Journal of Pharmacy and Pharmacology. 7, 2013,* **585-596.**

Antre, V. Rishikesh. *Microwave Assisted Synthesis of Novel Pyrazolone Derivatives Attached to A Pyrimidine Moeity and Evaluation of Their Antiinflammatory, analgesic and Antipyretics Activities. Saudi Pharmaceutical Journal 19, 2011,* **233–243.**

Kumar, Akhilesh. *Medicinal Plants as A Source of Antipyretics Agent in Terrain Region of Uttar Pradesh, India. Life Sciences Leaflets. 2, 2012,* **45-52.**

Eissa, A.M. Amal; Farag. A.H. Nahla; Soliman A.H. Galmal. *Synthesis, Biological Evaluation and Docking Studies of Novel Benzopyranone Congeners for Their Expected Activity as Anti-Inflammatory, Analgesic and Antipyretic Activity. Bioorganic and Medicinal Chemistry. 17, 2009,* **5059-5070.**

Nikitina, L. E., et al., Synthesis and Anti-Inflammatory And Antipyretics Activity Of 2-(1-Hydroxy-4-Isopropenyl-1-Methylcyclohexyl-2-Thio)-Methylethanoate. Pharmaceutical Chemistry Journal. 46, 2012, **23-25.**

Li, Jian, Y., et. al., *Synthesis of Aspirin Eugenol Ester and Its Biological Activity. Medicinal Chemistry Research.(21), 2012,* **995-999.**

Uramaru, N., et. al., *Design, Synthesis, and Pharmacological Activity of Nonallergenic Pyrazolone-Type Antipyretic Analgesics. Journal Of Medicinal Chemistry Research. (53), 2010,* **8727-8733.**

Uramaru, N., et. al., *Design, Synthesis, and Pharmacological Activity of Nonallergenic Pyrazolone-Type Antipyretic Analgesics. Journal Of Medicinal Chemistry Research. (53, 2010).* **8727-8733.**

Smith, G. C., O'Donnel, J.T**.,** *The Process of New Drugs and Discovery". First Edition*, Taylor&Francis Publisher. *2006:* **1-2.**

Doveston, RG., Taylor, R.J.K., *An expedient synthesis of the proposed biosynthetic precursor of the oxepine natural product, janoxepin. Tetrahedron Letters, 53, 2012* : **2533–2536.**

Doveston, RG., et al., *Total Synthesis of an Oxepine Natural Product, (±)-Janoxepin. Organic Letters, 14 (4), 2012*: **1122-1125.**

Lyssenko, M.K.A., Semenova, V.V., *Synthesis of substituted dibenz[b,f]oxepines from 2,4,6_trinitrotoluene, Russian Chemical Bulletin, International Edition, Vol. 58, No. 2, 2009:* . **347—350**.

Majumdar, KC., Ghosh, T., Ponra, S., *A reductive Mizoroki–Heck approach to dibenzo[b,e]oxepine, Tetrahedron Letters, 54, 2013:* **4661–4665.**

Kazemi, B., et al., *An efficient synthesis of 4H-chromene, 4H-pyran, and oxepine derivatives via one-pot three-component tandem reactions. Tetrahedron Letters, 53, 2012:* **6977–6981.**

Baur, B., et, al., *Metabolically Stable Dibenzo[b,e]oxepin-11(6H)-ones as Highly Selective p38 MAP Kinase Inhibitors: Optimizing Anti-Cytokine Activity in Human Whole Blood, Journal of Medicinal Chemistry, 56, 2013:* **8561-8578**.

DIVERSITY OF SECONDARY METABOLIT OF *ARTOCARPUS ALTILIS*

Erwin

Departmen of Chemistry, Faculty of Mathematics and Natural Sciences Mulawarman University

Jl. Barong Tongkok no. 4 Kampus Gn. Kelua Samarinda 75119, Indonesia

Email address: winulica@yahoo.co.id, *Hp: 085393691224*

ABSTRACT

Artocarpus altilis (Synonyms: Artocarpus communis and Artocarpus incisus.) Is a fast growing plant and spread it evenly in tropical and sub-tropical forests. In many countries, this plant is known as a traditional medicine such as in Taiwan is used as a remedy swelling of the liver, is anti-inflammatory, and has a detoxifying effect (detoxifyng), while in Indonesia, the leaves is using as an external medicine and to treat swelling of lymph. From various reports the results showed *A. altilis* contain steroids, chalcone, stilbene, flavonone, flavanone, aurone, and quinonoxanthone. Among the compounds which are found potentially as a hypo-allergenic and anti-tumor drug, tyrosinase and α-glucosidase inhibitory activities, and cathepsin inhibition.

Keywords: *Artocarpus altilis*, traditional medicine, flavonoids, and antitumor

INTRODUCTION

Artocarpus altilis (bread fruit), one of the plant of *Artocarpus* genus is native to New Guinea, Indonesia and Philippines. Currently they are cultivated on central and south America, Africa, India, Southeast Asia, Maldives, Srilanka and northern Australia (Hari, 2014). It is growing well in the tropics and subtropics region. This plant is widely spread in the tropical rain forests of Indonesia. Many people use *A. altilis* as a traditional medicine. *Artocarpus* plants (include *A. altilis*) is a rich source of Secondary metabolites as terpenoids, chalcons, flavonoids, stilbenoids, arylbenzofurans, neolignans, and Diels-Alder adducts compounds. *Artocarpus altilis* fruit is rich sources of carbohydrates, minerals and vitamins. Therefore it can be used as an alternative source of carbohydrates. (Akanbi et al, 2009; Deivanai and Bhore, 2010) and it can be a substitute for maize in poultry diet if properly processed (Oladunjoye et al. 2010).

The previous reports showing A. altilis Contain secondary metabolites that have biological activity as antiinflammatory, antioxidant, antifungal, sexual behavior, immunomodulatory, antidiabetic and antibacterial effect, toxic to *Artemia salina*, and antitumor activity. (Sikarwar *et al*, 2014 and Erwin *et al*, 2001). In Taiwan *Artocarpus altilis* used to prevent liver cirrhosis and hypertension and it is also reported to have anti-inflammatory properties and a detoxifying effect (Chen, 1993) and in Indonesia, this plant belonging to a medicinal plant where the leaves as an external medicine and to treat swelling of lymph (Heyne, 1987).

BIOACTIVITIES

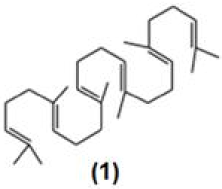
Artocarpus altilis (bread fruit) is used traditionally to treat various diseases and results of the investigation showed extracts of the leaves and bark of A. altilis are not toxic. (Sairam, S. and Urooj, A., 2014). The parts of *A. altilis* have several interesting activity. Ethanolic stem bark extract of *Artocarpus altilis* exhibits anti-inflammatory and antioxidant activities (Amponsah 2014). on the other hand, dichloromethane (DCM) of twig extract showed the highest antioxidant value compared with the others extracts (Kamal *et al*, 2012a) and it has promising therapeutic potential against bacteria and fungi (Kamal *et al*, 2012b). Likewise fruit extracts of *Artocarpus altilis* has immense potentiality for antibacterial activities (Pradhan et al, 2013).

Another study report on a part *A. altilis* (local name; *sukun*) show that wood extract has a potential as an anti-cancer agent (Arung *et al*, 2009). it is supported by a previous report where artoindonesian B was found from the heartwood extract of *Artocarpus altilis*. This compound has high activity against P-388 tumor cells (Erwin *et al*, 2001), while the compounds found from leaves have potential for anticancer applications (Fang *et al*, 2009).

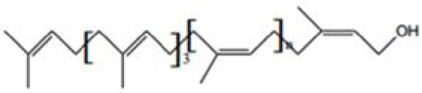
CONTENT OF SECONDARY METABOLITES

Terpenoid/Steroid

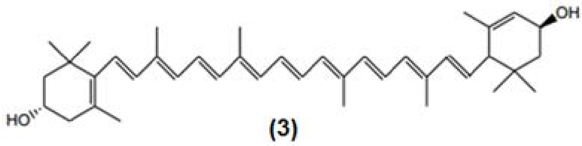
Terpenoids or steroids is one kind of secondary metabolites found in *A. altilis*. Squalene (1), polyprenol (2), lutein (3), cycloartenol (4) have been successfully isolated from dichloromethane extract of *Artocarpus altilis* leaves. b-Sitosterol (5), a steroid type was also found in this plant extract (Ragasa et al, 2014 and Sikarwar et al, 2014).



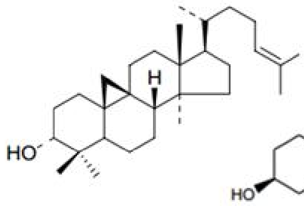
(1)



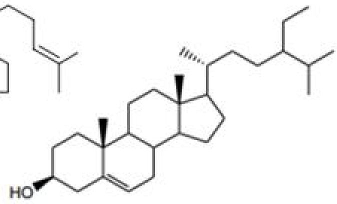
(2)



(3)



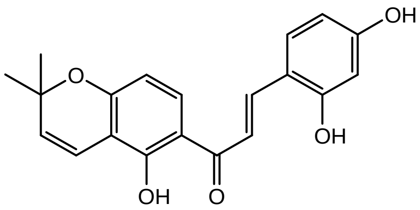
(4)



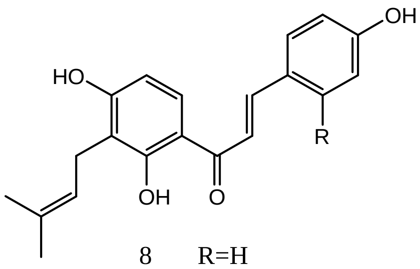
(5)

Chalcone

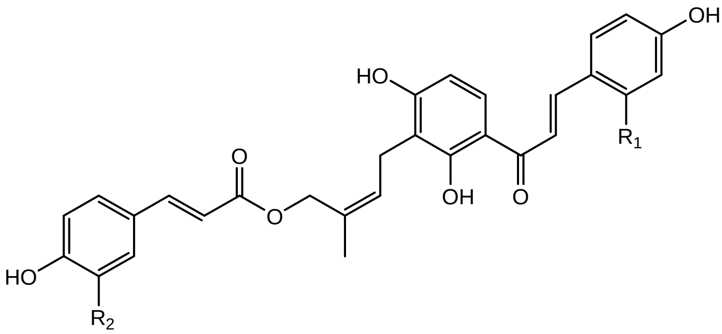
There are no reports of simple chalcon found in A. altilis as well as other species of Artocarpus. But all calchones found in this plant are prenylated or geranilated calchone derivative on the main frame of calchone. According to Hakim (2010) prenylation of chalcone by isoprenoid or geranyl groups can be found in ring A or B but cannot be found on Cα which is comparable to C3 on flavone. Han *et al* (2006) have reported five prenylated calchone obtained from extracts of *A. altilis* heartwood, namely 3",3"-dimethylpyrano[3',4']2,4,2'-trihydroxychalcone(7), isobacachalcone(8), morachalcone A (9), gemichalcone B (10), gemichalcone C (11). Compounds 7-10 exhibited potent inhibitory activity on nitric oxide production in RAW264.7.



7

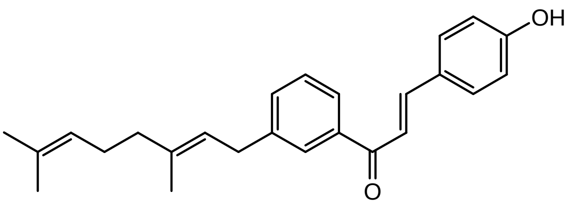


8 R=H
9 R=OH

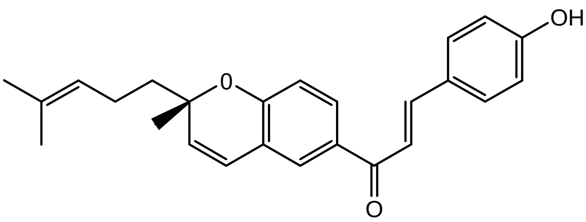


10 R_1 =H R_2 = H
11 R_1 = H R_2 = OCH_3

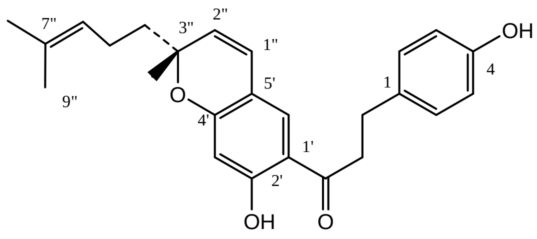
Geranilated chalcones derivative are also found in this plant such as Espeol (12) and Xanthoangelol (13), isolespeol (14), 5′-geranyl-2′,4′,4-trihydroxychalcone (15), and 3,4,2′,4′-tetrahydroxy-3′-geranyldihydrochalcone (16) (Fang *et al*, 2009) and AC-3-2 (17) (Nomura, 1998). These compounds are type of geranilated chalcone in ring A.



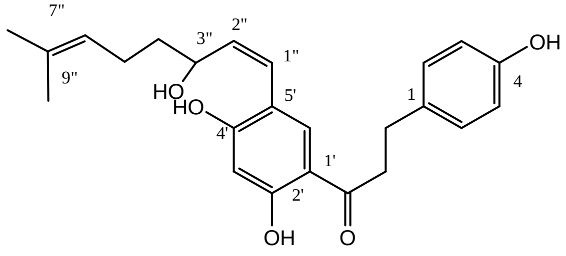
(12)



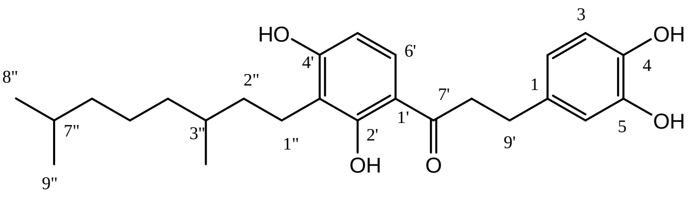
(13)



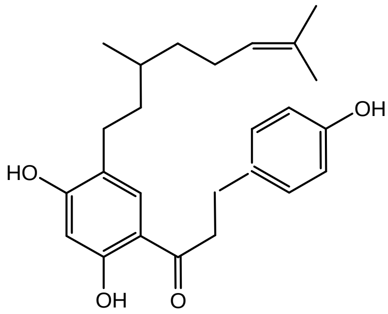
(14)



(15)

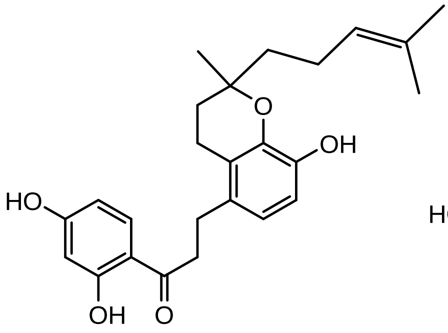


(16)

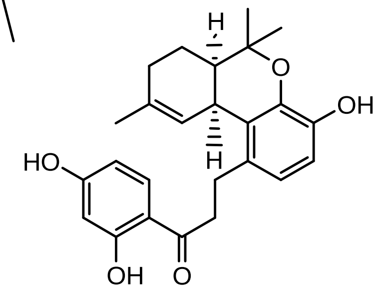


(17)

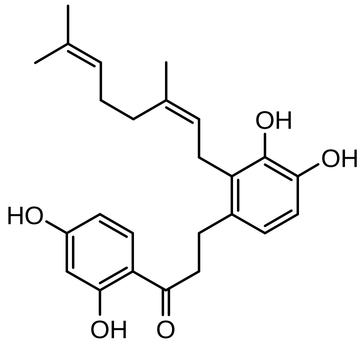
the other geranilation on chalcone also occur in ring B. Wang et al. (2007) have discovered three of these types of compounds from Artocarpus altilis, namely 1-(2,4-dihydroxyfenyl)-3-(8-hydroxy-2-methyl-2-(4-methyl-3-pentenyl)-2H-1-yl-5-benzopyran)-1-propanone (18), 1-(2,4-dihydroxyfenyl)-3-{4-hydroxy-6,6,9-trimethyl-6a,7,8,10 a-tetrahydro-6Hdibenzo (b,d) pyran-5-il}-1-propanone (19), 2-geranyl-2',3,4,4'-tetrahydroxydihydrochalcone (20), and Shah et al (2006) have found a 2-geranil-2 ', 4', 3,4-tetrahidroksidihidro-kalkon (21) and the potential of compound 21 as a hypo-allergenic and anti-tumor drug was patented by Fujimoto et al. 1987-1988 (Shah et al, 2006), AC-5-1 (22) (Nomura, 1998 and Patil, 2002) and AC-3-1 (23) (Nomura, 1998 ; Patil, 2002 and Fajriah et al, 2013).



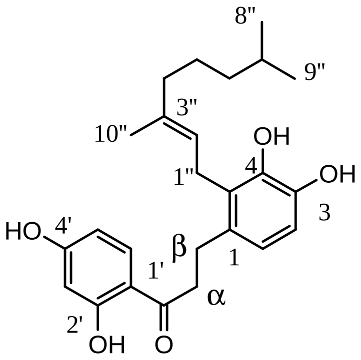
18



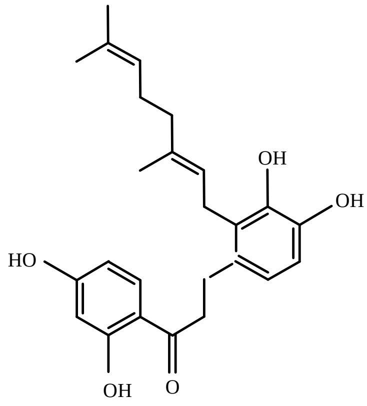
19



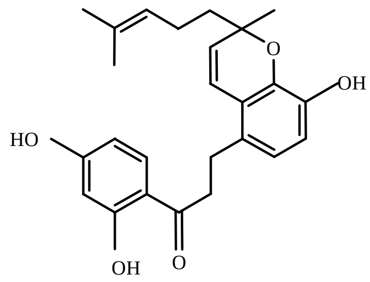
20



21

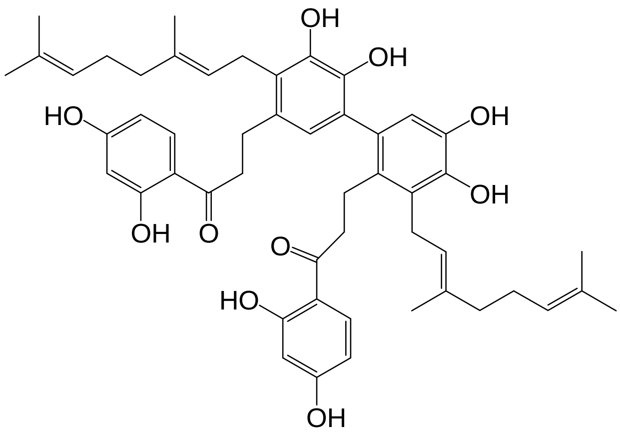


22



23

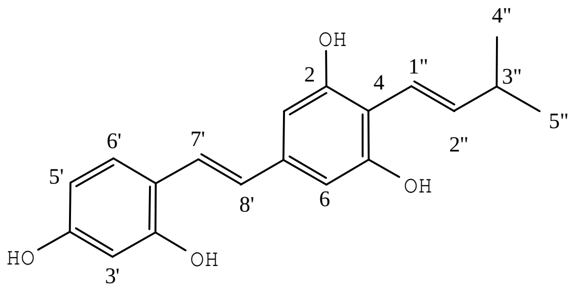
From MeOH/CH_2Cl_2 extract of the bud covers of *Artocarpus altilis* was found one a dimeric dihydrochalcone, cycloaltilisin 6 (24). Compounds 24 have IC_{50} values of 98 nM, in cathepsin inhibition. (Patil, 2002).



24

Stilbene

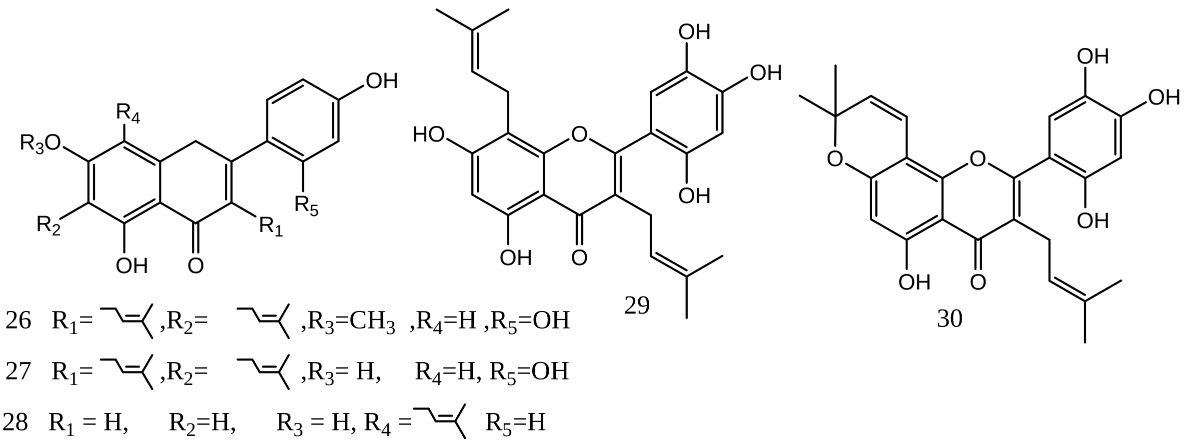
Stilbene type is rarely found in *A. altilis*. Only one stilbenene compounds that have been reported isolated from the stem wood and bark *A. altilis* namely Trans-4- (3-methyl-E-but-1-enyl) -3,5,2`, 4`-tetrahidroksi-stilbene (25) (Erwin, 2000 and Hakim *et al*, 2010).



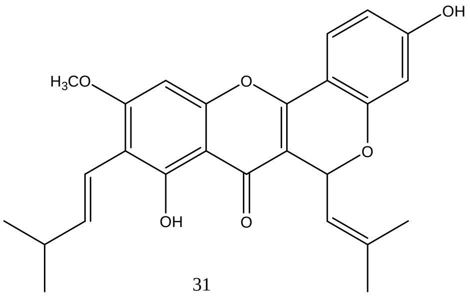
25

Flavones

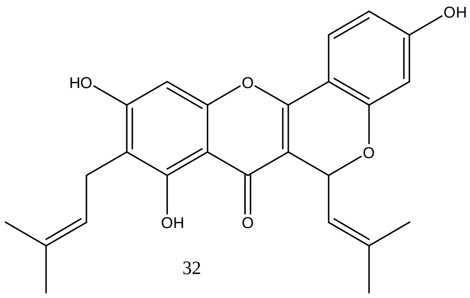
Generally, flavonoid which has been found in Artocarpus alitlis has prenylated at positions 3 in the frame of flavones. Prenylation may be occur in the free prenil form (26-30) and which has cyclization with hydroxyl group at position C-2 ' to form pyran or oxepin ring. From the wood A. altilis have been found artocarpin (26) (Erwin, 2000 and Han *et al*, 2006), cudraflavone C (27), licoflavone C (28) (Han *et al*, 2006), Artonin V (29) isolated from the root bark of A. altilis (Hano *et al*, 1994) and artonin E (30) (Aida *et al*. 1997). All the compounds are free prenylated at position C-3 except compound 28.



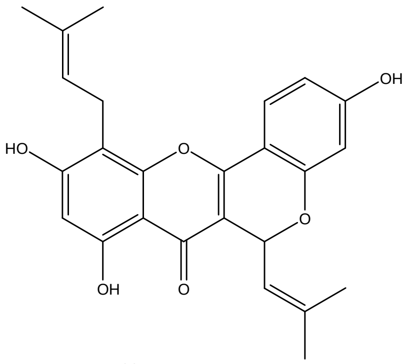
The other type is Piranoflavon. some types of these compounds have been found in altilis Artocarpus such as cycloartocarpin (31) (Erwin, 2000 dan Han et al, 2006), isocyclomulberrin (32), cyclomulberrin (33), cycloaltilisin (34) (Chen et al, 1993), and cudraflavone A (35) (Han, 2006), isocyclomorusin (synonym with cudroflavone) (35), and cyclomorusin (37) (Chen et al, 1993).



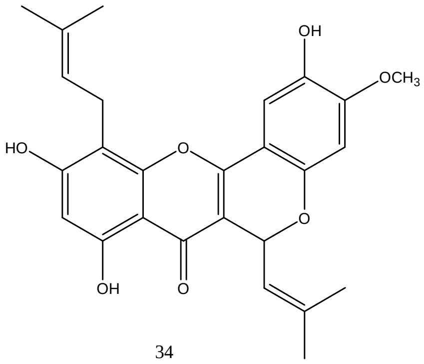
31



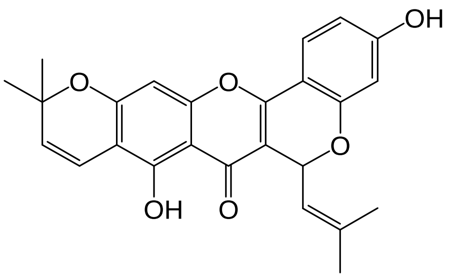
32



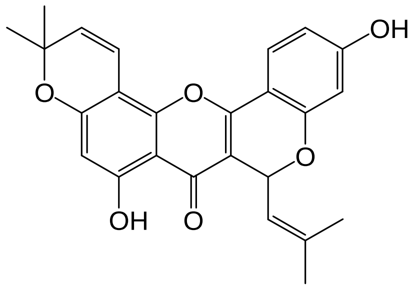
33



34

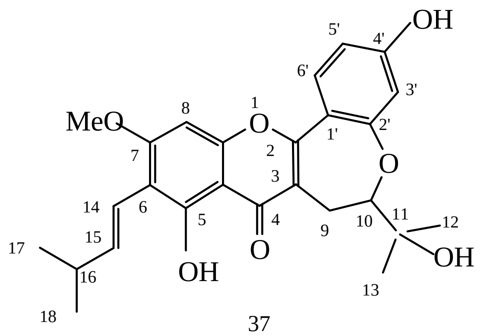


35

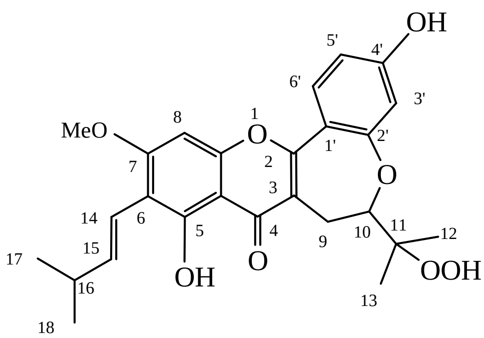


36

The compound type of oksepinoflavone also found in A. altilis such as chaplasin (37) and Artoindonesian B (38). Compound 38 shows the high activity against P-388 tumor cells (Erwin, 2000 and 2001)



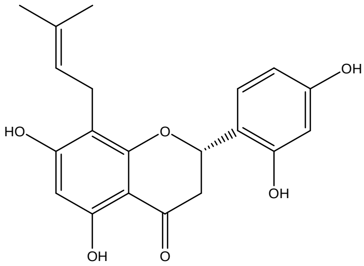
37



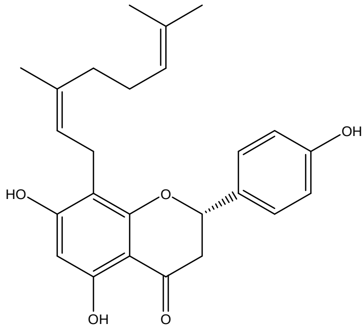
38

Flavanone

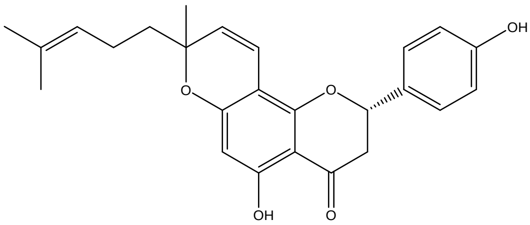
Only a few types of flavanone found in A. altilis such as (2S) -euchrenone (39) (Han *et al*, 2006) and 8-geranil-4', 5,7-trihidroksiflavanon (40) (Syah *et al,* 2006) and cycloaltilisin 7 (41) (Patil *et al*, 2002) have been isolated form A. altilis. Compound 39 exhibited too potent inhibitory activity on nitric oxide production in RAW264.7 (Han *et al*, 2006).



39



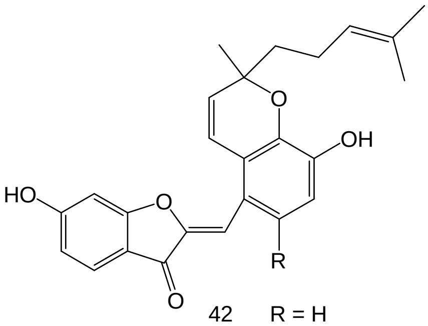
40



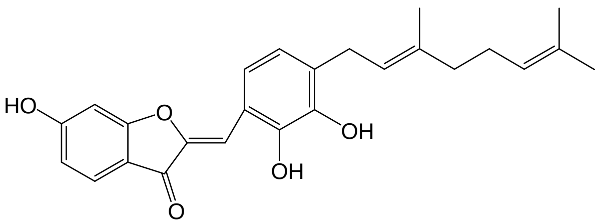
41

Aurone

Diversity of secondary metabolites in Artocarpus altilis shown by the discovery of the type aurone. From the MeOH extract of the leaves of *Artocarpus altilis* (Moraceae), three new aurones, altilisin H (**42**), I (**43**), and J (44) have been isolated. These compounds were found to show tyrosinase and α-glucosidase inhibitory activities. (Mai *et al*, 2012)



42 R = H
43 R = OCH_3

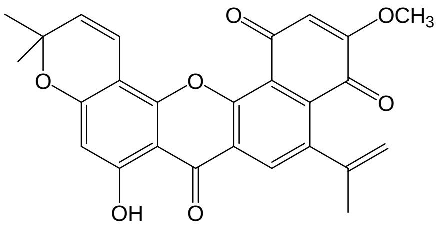


44

Quinonoxanthone

Quinonoxanthone is dihydrobenzoxanthone derived which it was formed from rearrangement on two hydroxy groups at C2' and C5' to form quinone ring.

Artomunoxantentrion (45) is one kind of type of compound has been found from the root bark of *A. communis* by Shieh *et al*. (1992).



45

CONCLUSION

Based on a variety of research reports indicate *Artocarpus altilis* containing steroids, chalcone, stilbene, flavonone, flavanone, aurone, quinonoxanthone. Among the compounds which are found there are potentially as a hypo-allergenic and anti-tumor drug, tyrosinase and α-glucosidase inhibitory activities, and cathepsin inhibition.

REFERENCES

Aida M, Yamaguchi N, Hano Y, Nomura T. 1997. Constituents of the Moraceae plants. 30. Artonols A, B, C, D, and E, five new isoprenylated phenols from the bark of *Artocarpus communis* forst. Heterocycles 45(1): 163-175.

Altman LJ, Zito SW. 1976. Sterols and triterpenes from the fruit of *Artocarpus altilis.* Phytochemistry 15: 829–830.

Amponsah, I. K., Annan, K., Koffuor, G.,A., Joseph Adusei Sarkodie, J.A., Umerie, I.J. and Wusu, S.O., 2014, Anti-inflammatory and antioxidant properties of the ethanolic stem bark extract of *Artocarpus Altilis* (Parkinson) Fosberg (Moraceae), Scholars Research Library Der Pharmacia Lettre, 6 (3):211-217

Akanbi T.O., Nazamid, S. and Adebowale, A.A, 2009, Functional and pasting properties of a tropical breadfruit (*Artocarpus altilis*) starch from Ile-Ife, Osun State, Nigeria, International Food Research Journal 16: 151-157

Arung, E.T., Wicaksono, B.D., Handoko, Y.A., Kusuma, I.W., Yulia, D. and Sandra, F. 2009, Anti-Cancer Properties of Diethylether Extract of Wood from *Sukun* (*Artocarpus altilis*) in Human Breast Cancer (T47D) Cells, Trop J Pharm Res, Tropical Journal of Pharmaceutical Research, 8 (4): 317-324

Chen, C.C; Huang, Y.L; Ou, J.L. 1993, Three New. Prenylflavones from *Artocarpus altilis J. Nat. Prod. 56*(9), 1594-1597

Deivanai, S. and Bhore, S.J. 2010, Breadfruit (*Atotocarpus altilis* Fosb)-An Underutilized and Neglecdted Fruit Plant Species, Middle-East Journal of Scientific Research 6 (5): 418-428

Erwin, 2000, Phenolic Compound from *Artocarpus Altilis* (Park.) Fosb., Thesis, Institut Teknologi Bandung, Bandung.

Erwin, Achmad, S. A., Syah, Y. M., Aimi, N., Hakim, E. H., Kitajima, M., Makmur, L., Mujahidin, D. and Takayama, H. 2001, Artoindonesianin B, a cytotoxic compound against P388 tumor cells from *Artocarpus altilis. Bull. Soc. Nat. Prod. Chem (Indonesia).* 1(1): 20-27.

Fajriah, S., Mozef, T., Artanti, N., Lotulung, P.D.N. and Abbas, J. 2013, Isolation of Prenylated Flavonoid from Ethyl Acetate Fraction of *Artocarpus altilis* Leaves using Counter-Current Chromatography, Asian Transactions on Basic and Applied Sciences (ATBAS ISSN: 2221-4291) Volume 02 Issue 06, 6-9.

Fang, S.C., Hsu, C.L., and Yen, G.C., 2009, Cytotoxic Effects of New Geranyl Chalcone Derivatives Isolated from the Leaves of Artocarpus communisin SW 872 Human Liposarcoma Cells, J. Agric. Food Chem.56,8859–8868

Fujimoto, Y., S. Agusutein, and S. Made, 1987, Isolation of A Chalcone Derivative and Antitumor Compositions Containing It, Jpn. Kokai Tokkyo Koho, 5 hal, CODEN: JKXXAF JP 62270544 A2 19871124 Showa, Paten ditulis dalam bahasa Jepang, aplikasi: JP 86-50070 19860307.

Fujimoto, Y., Y. Koshihara, S. Made, and S. Agusutein, 1988, Isolation of 2-Geranyl-3,4,2',4'-tetrahydroxychalcone as An Antiallergy Agent, Jpn. Kokai Tokkyo Koho, 5 hal, CODEN: JKXXAF JP 63023816 A2 19880201 Showa, paten ditulis dalam bahasa Jepang, aplikasi: JP 86-167288 19860716.

Hakim, A. 2010, Diversity of secondary metabolites from Genus *Artocarpus* (Moraceae), *Bioscience*, 2 (3),146-156

Hano Y, Inami R, Nomura T. 1994. Constituents of Moraceae plants. 20. a novel flavone, artonin V, from the root bark of *Artocarpus altilis*. J Chem Res Syn 9: 348-349.

Hari, A., Revikumar K G, and Divya, D. 2014, Artocarpus: A Review of Its Phytochemistry and Pharmocology, Journal of Pharma Search V ol. 9 (1): 7 -12.

Han, A.R., Kang, Y.J., Windono, T., Sang Lee, S.K. and Seo, E.K. 2006, Prenylated Flavonoids from the Heartwood ofArtocarpus communiswith Inhibitory Activity on Lipopolysaccharide-Induced Nitric Oxide Production, *J. Nat. Prod*. 69,719-721.

Heyne, K., 1987, Tumbuhan berguna Indonesia, Departemen Kehutanan Republik Indonesia, Jakarta.

Kamal, T. Muzammil, A., Abdullateef, R.A., and Omar, M.N. 2012a, Investigation of antioxidant activity and phytochemical constituents of Artocarpus altilis, Journal of Medicinal Plants Research Vol. 6(26), pp.4354-4357

Kamal, T., Muzammil, A., and Omar, M.N. 2012 b, Evaluation of antimicrobial activity of Artocarpus altilison pathogenic microorganisms, Science Series Data Report, 4 (9), 41-48.

Mai, N.T.T., Hai, N.X, Phu, D.H., Huu, P.N., Nguyen, T., and Nhan, T., 2012, Three new geranyl aurones from the leaves of Artocarpus altilis, Phytochemistry Letters, *5* (3), 647-650

Nomura, T; Hano, Y; Aida, M. Isoprenoid-substituted flavonoids from Artocarpus plants (moraceae). *Heterocycles,* 1998, *47*(2), 1179-1205

Oladunjoye, O., Ologhobo, A.D., and Olaniyi, C.O, 2010, Nutrient composition, energy value and residual antinutritional factors in differently processed breadfruit (Artocarpus altilis) meal, African Journal of Biotechnology Vol. 9 (27), pp. 4259-4263.

Patil, A. D., A. J. Freyer, L.Killmer, P. Offen, P. B. Taylor, B. J. Votta, and R. K. Johnson, 2002, A New Dimeric Dihydrochalcone and A New Prenylated Flavone from The Bud Covers of Artocarpus altilis: Potent Inhibitors of Cathepsin K, J. Nat. Prod., 65:4, 624-627.

Pradhan, C., Mohanty, M., Rout, A. Das, A.B., Satapathy, K.B., and Patra, H.K. 2013, PHYTOCONSTITUENT SCREENING AND COMPARATIVE ASSESSMENT OF ANTIMICROBIAL POTENTIALITY OF ARTOCARPUS ALTILIS FRUIT EXTRACTS, Int J Pharm Pharm Sci, Vol 5, Issue 3, 840-843

Ragasa, C.Y.,Antonio Ng, V., Park, J.H., Kim, D.W., Cornelio, K., and Shen, C.C. 2014, Chemical Constituents of Artocarpus altilis and Artocarpus odoratissimus, Research Journal of Pharmaceutical, Biological and Chemical Sciences, 5(4), Page 1081-1087

Sikarwar, M.S., Hui, B.J., Subramaniam, K., Valeisamy, B.D., Yean, L.K., and Balaji, K., 2014 A Review on Artocarpus altilis (Parkinson) Fosberg (breadfruit), *Journal of Applied Pharmaceutical Science,* 4 (08), 091-097

Sairam, S. and Urooj, A., 2014, Safety Evaluation of Artocarpus altilisas Pharmaceutical Agent in Wistar Rats, Journal of Toxicology, Volume 2014, 1-8

Shieh WL, Lin CN. 1992. A quinonoid pyranobenzoxanthone and pyranodihydrobenzoxanthone from Artocarpus communis. Phytochem 31 364-367

Sikarwar, M.S., Hui, B.J., Subramaniam, K., Valeisamy, B.D., Yean, L.K. and Balaji, K. 2014, A Review on Artocarpus altilis (Parkinson) Fosberg (breadfruit), Journal of Applied Pharmaceutical Science Vol. 4 (08), pp. 091-097.

Syah, Y.M., Achmad, S.A., Bakhtiar, E., Hakim, E.H., Lia Dewi Juliawaty, L.D., dan Latip, J., 2006, Dua Flavonoid Tergeranilasi dari Daun Sukun (Artocarpus altilis), JURNAL MATEMATIKA DAN SAINS, SEPTEMBER 2006, VOL. 11 NO. 3, 100-104.

Wang Y, Xu K, Lin L, Pan Y, Zheng X. 2007. Geranyl flavonoids from the leaves of *Artocarpus altilis*. *Phytochem*, 68: 1300-1306.

The Potential Of Secondary Metabolites Compounds Of Methanol Extract Stem Bark *Melochia umbellate* As Anti-Bacterial

Usman[1], Nunuk Hariani S[2], Hanapi Usman[2], and Ahyar Ahmad[2]

[1] Staff Pengajar Prodi Kimia FKIP Universitas Mulawarman

[2] Staff Pengajar Jurusan Kimia Unhas

ABSTRACT

A Study antibacterial essay of the methanol extracts of steam bark *M.umbellate* (Houtt) Stapf var. degrabrata (Paliasa). The results of this study showed that the methanol extract from the bark of *M. umbellate* (Houtt) Stapf var. degrabrata group of compounds containing alkaloids, flavonoids, triterpenoids, phenolics and saponins. Methanol extract from the bark of *M. umbellate* can inhibit the growth of bacteria *Bacillus subtilis, Staphylococcus aureus,* gram-negative bacteria as well as representing *Escherichia coli, Salmonella thypi*, and *Pseudomonas aeruginosa* representing gram-positive bacteria. At a concentration of 400 ppm of methanol extracts of these plants showed effective barrier against bacteria tested, with a zone of inhibition, respectively as follows: 12.67 mm against bacteria *B. subtilis,* 12.97 mm against bacteria, *S. aureus,* 11.86 mm against bacteria *E. coli* and 12.12 mm against bacteria *S. thypi*. However, methanol extract from the bark of *M. umbellate* showed no impediments to the growth of bacteria *Pseudomonas aeruginosa*.

Keywords: Antibacterial essay, methanol extract of *M. umbellate*

INTRODUCTION

Sterculiaceae is a tropical plant genus consists of 70 species and 1500. Most species of the families of plants such as trees and shrubs (Mabberley, 1997). Groups of plants are widely used by people as food, housing and traditional medicine. For example *Kleinhovia hospita* Lin since formerly used as a traditional medicine in several countries including China, Malaysia, Papua New Guinea and Indonesia to treat hepatitis, scabies, Tetter and pruritus (Gan, et al., 2009). Sterculia setigara Del (*Melochia tomentosa*) and *Sterculia tragacantha* Lindl are two species of the family Sterculiaceae most widely used as a traditional medicine in West Africa to treat dysentery, ulcers, syphilis, epilepsy, and malaria (Igoli, et al., 2005). Dry powder of the leaves of the plant S. setigara normally used by the doctors in the state of Bauchi (Nigeria) for the treatment of tuberculosis (chronic cough with blood stains) and HIV / AIDS (Babalola, et al., 2012).

Paliasa is a plant that is included in the family Sterculiaceae. The plant consists of three different plant species are of the genus *Kleinhovia hospita* Linn of the genus Kleinhovia, while *Melochia umbellata* (Houtt) Stapf var. degrabrata and *Melochia umbellata* (Houtt)

Stapf var. visenia that both of the genus Melochia. Paliasa plant is widely used in South Sulawesi as a traditional medicine for the treatment; liver disease, hypertension, diabetes, cholesterol and hepatitis (Raflizar, *2006*). *K. hospita* leaves and bark are used as a cough medicine, then the content of cyanogenic compounds are assumed to kill ectoparasites such as lice. Leaf extracts showed antitumor activity against sarcoma in mice. The third methanol extract of leaves of these plants can improve heart function of mice induced with karbontetraklorida, but *M.umbellate* (Houtt) Stapf var. degrabrata most effective in improving liver function (Lalo, A., 2003.).The three types of leaf extracts paliasa also toxic to larvae shrimp *Artemia salina*, where the plant leaf extract of *M. umbellate* (Houtt) Stapf var. degrabrata that showed the most toxic among other types paliasa leaf extract (Tayeb, et al., 2007).

So far the data has not been much research exploring paliasa bioactive compounds from plants as raw material, especially anti-bacterial species *M. umbellate* (Houtt) Stapf var degrabrata. Some results of research on the nature of the toxicity and other bioactive properties of plants have been reported paliasa namely; results of toxicity screening of methanol.

METHODS

Extraction and Phytochemical Test

A total of 5.25 kg finely powdered bark of *M. umbellate* (Houtt) Stapf var. degrabrata (Paliasa) macerated with methanol for 1 x 24 hours (3 times). The methanol extract was filtered and collected then concentrated under reduced pressure using an evaporator to obtain a methanol extract of brown as much as 393, 58 grams. The methanol extract was taken as much as 10 grams and put in a bottle vial to be tested phytochemical and anti-tuberculosis test. Phytochemical test is conducted, the alkaloid test with reactant Meyer, Wagner and Dragendorf; flavonoids test with reactant (Mg powder in 0.2 ml of concentrated HCl), phenolic test with FeCl3 reagent, triterpenoids and steroids test with LB and Salkowski reagent and test reagent saponin with foam. Phytochemical test results can be seen in Table 1.

Antibacterial test

Test bacteria used in this study comes from a pure culture laboratory of Microbiology, Faculty of Pharmacy Unhas. Bacteria test consists of gram-positive bacteria (B. subtilis and S. aureus) and Gram-negative bacteria (P. aeruginosa, E. coli and S. thypi). The bacteria rejuvenated in TSA medium in slanted tubes for 2 x 24 hours at a temperature of 25 ° C. Colonies were grown in agar slant taken one loop, and then homogenized with 9 ml of saline solution, and incubated at 10 cm petri dish containing medium Mueller Hinton Agar (MHA). Test performed with an anti-bacterial agar diffusion method using paper discs (paper disc) 6 mm diameter were deposited on the surface of MHA medium. Subsequently dropped by 20 mL extract and isolate the compound, and then incubated for 2 x 24 hours at a temperature of 25 ^{0}C. Testing the activity of methanol extract performed by measuring zone of inhibition on bacterial culture using a sliding bar that is expressed in mm.

Methanol Extracts Against Bacteria Test for *M. tuberculosis*

Inhibition test methanol extract against bacterial test done by the diffusion method using couplers bottle. A total of 5 bottles that have been sterilized LJ medium was prepared, the first bottle was added a solution of 20 mL of DMSO (negative control), the second bottle just berisim LJ medium, third and fourth bottles each methanol extract was added to a concentration of 100 ppm and 200 ppm as 20 mL, added a fifth bottle rifampicin (tuberculosis medicine) to 20 mL as a positive control. Subsequently the fifth screw bottles were incubated at 37 ^{0}C for 3 weeks. The test results on the inhibition of methanol extract of *M. tuberculosis* can be seen in Figure 1.

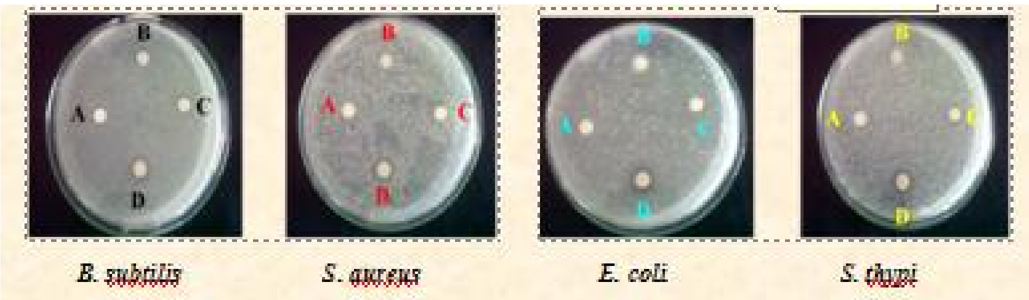


Figure 1 The observation of inhibition of methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata (paliasa) against the test bacteria

Keterangan :

A = negative control

B = conct.exstract 100 ppm

C = conct.exstract 200 ppm

D = conct.exstract 400 ppm

Table 2 Results of antibacterial tests methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata K

No.	Conct. Ppm	zone diameter of bacterial inhibition (mm)			
		S. aureus	*B.subtilis*	*E. coli*	*S. thypi*
1	100	t.m	8,15	t.m	t.m
2	200	9,42	11,05	t.m	8,17
3	400	12,67	12,97	11,58	12,12
4	KN	t.m	t.m	t.m	t.m
5	KP	14,95	14,00	14,25	14,00

Description :

KN = Negative control (DMSO)

KP = Positive control

t.m = no inhibition

Antibacterial test results as seen in Table 2, showed that the methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata have inhibitory effect on both types of bacteria (gram negative and gram positive bacteria). It can be explained that the active compounds in the methanol extract qualitatively or quantitatively important role on the cell membrane of gram-negative bacteria and gram-type positive (Hanaa et al., 2011). According to Calderon and Sabundayo (2007) the effect of the antibiotic activity of plant extracts against bacterial growth may be caused by the following factors, among others; reaction mechanisms, chemical structure, or spectrum of activity. Broad-spectrum antibiotics in plants affect the growth of various bacteria, both gram-negative bacteria and the type of target gram-positive bacterial cell wall or cell membrane or interfere with essential bacterial enzymes (Sowmya. Et al., 2011).

Test results methanol extract bioactivity against test bacteria showed that the methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata showed inhibitory effect on bacterial growth at a concentration of *M. .tuberkulosis* 100 ppm and 200 ppm. It can be explained that the active compounds in the methanol extract qualitatively or quantitatively important role on the cell membrane of gram-negative bacteria and gram-type positive (Adeniyi, et al.,2004)

Description :

KN = Negative control (DMSO)

M = Medium

EM-1 = Methanol extract 100 ppm

EM-2 = Methanol extract200 ppm

KP = Positive control (rifampisin)

Figure 1 Power inhibition of methanol extract of the stem bark of *M. umbellate*

(Houtt) Stapf var. degrabrata (paliasa) against Mycobacteria tuberculosis

Effect of antibiotics in plant extracts against bacterial growth may be caused by the following factors include reaction mechanisms, chemical structure, or spectrum of activity. Broad-spectrum antibiotics in plants affect the growth of various bacteria, both gram-negative bacteria and the type of target gram-positive bacterial cell wall or cell membrane or interfere with enzymes in the process of protein synthesis in bacteria (Mann, et al., 2008)..

The content of phytochemicals such as alkaloids, flavonoids, tannins, phenols, saponins, and several other aromatic compounds are plant secondary metabolites that play an important role in the defense mechanism against harmful microorganisms and herbivorous insects other (Sonibare, et al., 2009). The existence of groups such as phenolic compounds, tannins, saponins, and steroids in the extract can act as an antimicrobial. Class of compounds tannins will bind proline-rich proteins and interfere with the process of protein synthesis. Antimicrobial properties of phenolic among others; degrade cell walls, interact with and disrupt the cytoplasmic membrane composition, membrane protein damage, destroy enzymatic mechanism for energy production and metabolism, as well as alter nutrient uptake and electron transport. Moderate steroid compounds has been reported to have antibacterial properties, because steroids cause leakage of liposomes (Adeniyi, et al., (2004).

Class of compounds tannins will bind proline-rich proteins and interfere with the process of protein synthesis. Antimicrobial properties of phenolic among others; degrade cell walls, interact with and disrupt the cytoplasmic membrane composition, membrane protein damage, destroy enzymatic mechanism for energy production and metabolism, as well as alter nutrient uptake and electron transport. Moderate steroid compounds has been reported to have antibacterial properties, because steroids cause leakage of liposomes (Almagboul, et al., 1988)..

Conclusions

1. Methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata class of compounds containing alkaloids, flavonoids, triterpenoids, phenolic and saponin.
2. The methanol extract of the stem bark of *M. umbellate* (Houtt) Stapf var. degrabrata potential as an antibacterial against both types of bacteria is gram negative and gram positive bacteria
3. Methanol extract of *M. umbellate* (Houtt) Stapf var. degrabrata have inhibitory effects against M. tuberculosis at a concentration of 100 ppm and 200 ppm

Acknowledgements

1. Thanks, go to the Department of Chemistry, Laboratory of Organic Chemistry and

Laboratory of Microbiology, Faculty of Pharmacy Faculty of Hasanuddin University who has provided facilities to conduct this research.

2. Our thanks are also conveyed to the Bogor-based, Center for Research and Development of Botany, Biological Research and Development Center (LIPI), Bogor, which has been identified specimens of this plant

References

Adeniyi, B.A., Groves, M.J., and Gangadharam, P.R., (2004). In Vitro Antimycobacterial Activities of Three Spesies of Cola Plant extracts (Sterculiaceae), *Phytother Res*, 18: 414 – 418.

Almagboul, A.Z., Bashiru, A.K., Farouk, A., Salih, A.K. (1988). Antimicrobial Activity of Certain Sudanese Plants Used in Folklorik Medicine: Screening for Antibacterial Activity (1V). *J. Fitoterapia,* Vol. 56 (6) pp.331-337

Babalola, I.T., Adelakun E.A., Wang Y, Shode, F.O., 2012, Anti-TB Activity of *Sterculia setigera* Del., Leaves (*Sterculiaceae*), *Journal of Pharmacognosy and Phytochemistry*. Vol. 1 No. 3, Online Available at www.phytojournal.com.

Erwin, Noor, A., Soekamto, N.H., Harlim T. 2009, Skrining Bioaktivitas Beberapa Bagian Jaringan Tumbuhan Paliasa, *Melochia umbellata* (Houtt). Stapf var. Degrabrata. *J. Indonesian Chemica Acta*, Vol. 2, No. 1, Juni 2009.

Erwin, Noor, A., Soekamto, N.H., Harlim T. 2010, Penentuan Struktur Molekul Isolat Kayu Batang *Melochia umbellata* (Houtt). Stapf var. Degrabrata K (Paliasa) dan Uji Sel Murin Leukimia P-388. *Disertasi, tidak diterbitkan, Program Studi Kimia PPS UNHAS*, Makassar.

Gan, Li-She, Ren, G., Mo, Jian-Xia, Zhang, Xiang-Yi, Yao, W., and Zhou Chang-Xin, 2009, Cycloartane Triterpenoids from Kleinhovia hospital Linn, J. Nat. Prod., 72, 1102 – 1105.

Heyne, K., 1987, *Tumbuhan Berguna Indonesia***,** Jilid II, Yayasan sarana Warna Jaya, Jakarta.

Igoli, J. O., Ogaji, O. G., Tor- Anyiin, T. A., Igoli, N.P. (2005). *Medicinal Practices among the Igede people of Nigeria Part II*, *African Journal of Complementary and Alternative Medicine*, Vol.2, Ibrahim T. Babalola, Esther A. Adelakun, Yuehong Wang, Francis O. Shode Vol. 1 No. 3 2012 www.phytojournal.com Page | 26

Lalo, A., 2003. Perbandingan Efek Ekstrak Metanol Berbagai Jenis Daun Paliasa Terhadap Fyngsi Hati Mencit Jantan, *Skripsi*, Jurusan Farmasi FMIPA Unhas Makassar.

Mabberley, D.J., 1997, *The Plant-Book: A Portable Dictionary of the Vascular Plant,* Second ed. Cambridge University Press, 1 – 874.

Mann A, Amupitan J.O, Oyewale A.O, Okogun J.I , Ibrahim K, Oladosu P, Lawson I, Olajide I and Nnamdi A (2008).Evaluation of *in vitro* antimycobacterial activity of Nigerian plants used for treatment of respiratory diseases .*African Journal of Biotechnology* 7 (11):1630-1636.

Raflizar., Adimunca., dan Tuminah, S. *2006.* Dekok Daun Paliasa (*Kleinhovia hospital* Linn) Sebagai Obat Radang Hati Akut. *Cermin Dunia Kedokteran*. 50, 10-14.

Ridhay, A., Noor, A., Soekamto, N.H., dan Harlim, T., 2011. Isolasi dan Uji Antibakteri Senyawa Steroid dari Kayu Akar *M. umbellate* (Houtt) Stapf var. degrabrata K. *Jurnal Kesehatan Bung*, 1(4): 43 – 46, Desesmber 2011.

Soekamto, N.H., Noor, A., Dini, I., Rudiansyah and Merry, G. 2008. Coumarin and Steroid Compound from Stem Bark of Kleinhovia hospital Linn. *Proceeding on the International Seminar on Chemistry 2008*, The Role of Chemistry in The Utilization of Natural Resources, Bandung 30 – 31 October 2008.

Sonibare M. A, Soladoye M.O, Esan O.O, and Sonibare O.O, 2009, "Phytochemical and antimicrobial studies of four species of Cola Schott & Endl. (Sterculiaceae)," *African Journalof Traditional, Complementary and Alternative Medicines*, vol. 6, no. 4, pp. 518–525.

Sowmya G.S., Vinayachandra, Syed Hidayathulla and K.R. Chandrashekar. 2011. Antimicrobial Activity and Phytochemical Screening of *Pterospermum reticulatum* Wight and ARN, *International Journal of Pharmacy and Pharmaceutical Sciences*, Vol. 3,5,2011.

Tayeb, R., Alam, G., Wahyudin, E., 2007. Toksisitas Ekstrak Daun Paliasa Jenis *Kleinhovia hospita*, *Melochia um*bellata var. Degrabrata dan *M. umbellate* var. Visenia Terhadap Larva *A. salina* Leach. *Majalah Obat Tradsional.*

Watson, L., Dalwit, M.J. 1992. The Famillies of Flowering Plants Sterculiaceae Vent. (online) *(http://www.Sterculiaceae.html)* diakses 20 Maret 2010.

EXTRACTION KINETICS OF SAPPANG WOOD DYES

(*Caesalpinia sappan* Linn)

Suryani

Department of Chemical Processing Engeneering , Politeknik Ati Makassar

Makassar, Indonesia, 55281

* Corresponding author, email : suryaniakkas@yahoo.com

ABSTRACT

The development of food and beverage processing industry and the limited quantity and quality of natural dyes cause the use of synthetic dyes is increasing. The use of synthetic dyes can be replaced with natural dyes. One alternative that can be used natural dyes are dyes contained in Sappang wood (*Caesalpinia sappan Linn*.) For that conducted this research with the Ethanol Concentration and Temperature Effect to Extraction Sappang wood dye. The purpose of this study was to determine the effect of ethanol with various concentrations and temperatures as well as get the highest weight of the extract to the extraction of wood dye sappang.

The research method used is the extraction of heat by using a set of equipment sokhlet. The treatments consisted of two variables, ethanol with various concentrations (70%, 80%, and 90%) and extraction temperature (60 ^{0}C, 70 ^{0}C, and 80^{o}C).

The results showed that the higher concentration of ethanol and the temperature the higher the percentage by weight of dry extract of Sappang wood dye produced. The highest extraction results obtained at a temperature of 80 ° C and the concentration of 90% by weight of dry extract yield the highest 0.7419 grams and percentages 9:27% and extraction kinetics is 3:24 10-3mol liter-1 s-1.

Keywords: dye, Sappang wood, ethanol, temperature, and extraction kinetics

INTRODUCTION

Dyestuff is a complement to the appeal of foods, beverages as well as flavors such as spices. The addition of dyestuff in foods, beverages, and spices have a very big influence on the taste and attractiveness consumers.

Technological development became one of the triggering factors and the growing need for food additives, but its use is often not as intended, as an example of the use of textile dyes for foodstuffs because the price is cheaper than food coloring. The lack of socialization about a dose of, the benefits and hazards of the use of food additives incorrectly may be one cause. The use of food additives today is very diverse, ranging from fragrance and preservatives until the giver colorings.

The use of synthetic dyes or textiles can be replaced with natural dyes, one of which is the dye of wood Sappang (*Caesalpinia Sappan L.*) is commonly used as a food coloring and drinks because it produces a red color - yellow dye produced by named brazilin.

Sappang wood dyes extraction has been done before by using different types of solvents. The quantity of water solvent provide dye extract the most volume, but in quality ethanol extract showed better results, because brazielin stable in ethanol. Therefore research Sappang wood dye extraction followed by using ethanol.

The purposes research were : to Determine the influence of variations in temperature and concentration of etanol, the yield and the extracion kinetics of Sappang wood dyes.

EXPERIMENTAL SECTION

Materials

Material is used in this study were ; sawdust Sappang wood and ethanol in the variation of concentration.

Equipment

A set of sokhlet apparatus, heat mantle, oven, digital balance, blender, rotary evaporator, and thermometer,

Variable of Experiment

a. Constant Variable

1) Weight sawdust Sappang : 8 gr
2) Volume of Etanol : 175 ml
3) Exraction time : 2 jam

b. Changed Variable

1) Concentration of etanol : 70 %, 80 %, and 90 %
2) Temperature of reaction : 60 ^{o}C, 70^{o} C , dan 80^{o} C

Procedure

1. Prepared the sappang wood sample

   Sappang wood as much 1 kg were cleaned, chopped / minced then put in the oven at 70 ° C, for 2 x 7 hours, and then pulverized with a blender and then, weighed as much as 8 gram.

2. Ekstraction

   Sappang sawdust extracted by heat treatment using a set of tools sokhlet with various concentrations of ethanol and extraction temperature variations.

RESULTS AND DISCUSSION

The influence of Temperature and Concentration variation on the extraction of dyes sappang wood

Weights dyes extracted is produced from the research in influenced of ethanol concentration and temperature variation against extraction dyes Sappang wood can be seen in the table below.

Table 1. The Yield of Extraction dyes Sappang Wood

Concentration of Ethanol (%)	Temperature (^oC)		
	60	70	80
70	0.5284 gr	0.5557 gr	0.5786 gr
80	0.6919 gr	0.7161 gr	0.7262 gr
90	0.7320 gr	0.7399 gr	0.7419 gr

The Sappang wood extraction results in the table above showed that Sappang wood dyes extract lowest weight was obtained at a concentration of 70% and a temperature of 60 ° C, and the highest weight of the dye extract at a concentration of 90% and a temperature of 80 ° C.

The results of Sappang wood extraction was obtained as dry extracted from the use of varying ethanol concentrations and temperatures can be seen in the figure 1 and 2 below.

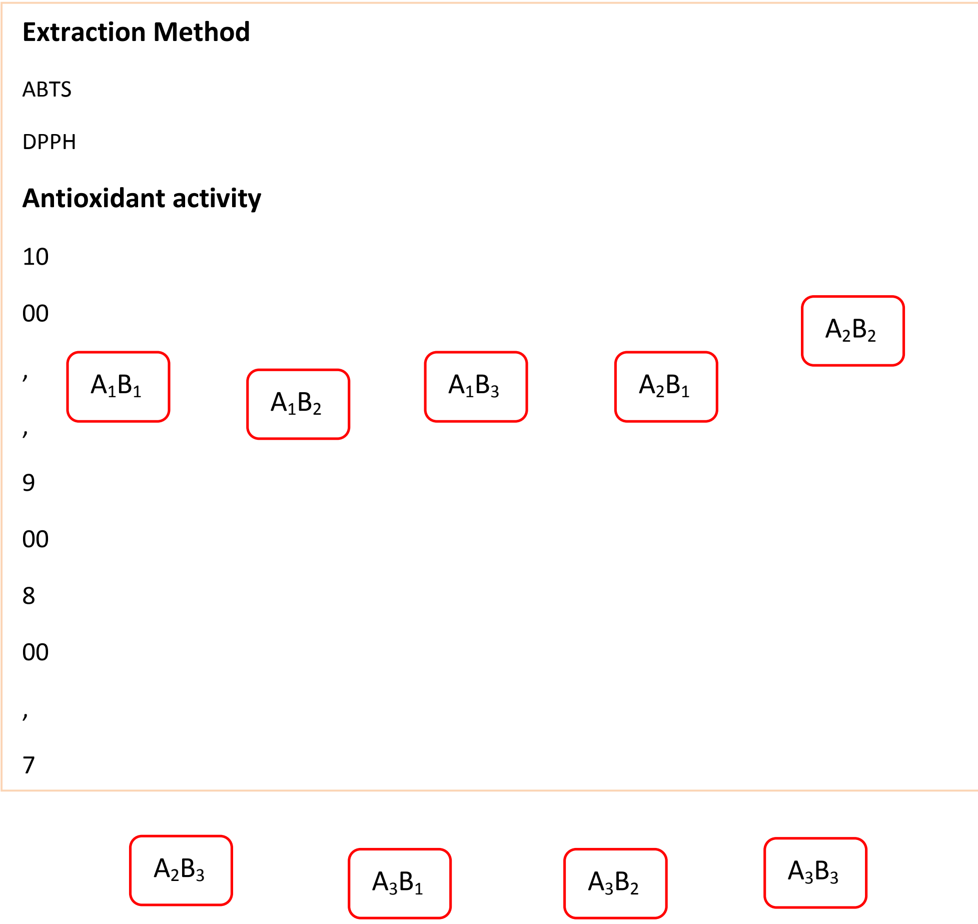


Fig.1 Dry extract of Sappang Wood Dyes

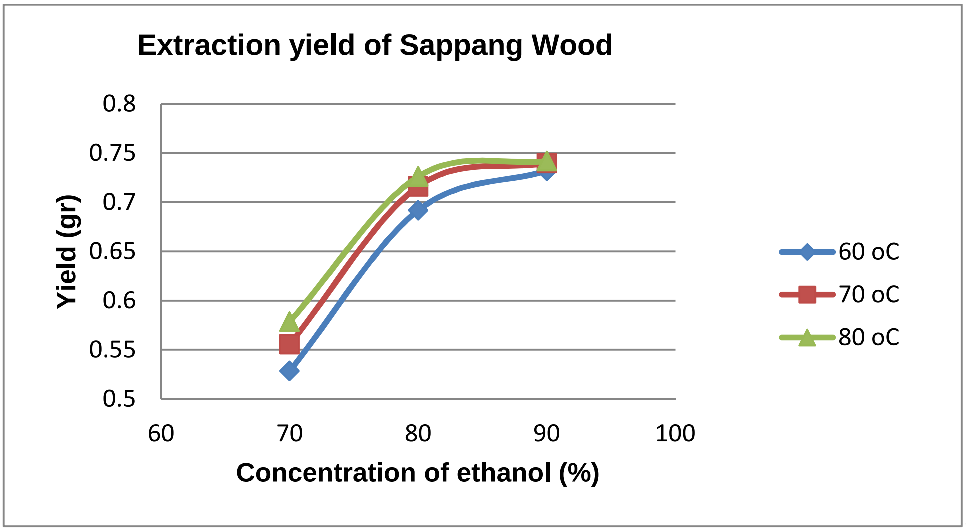


Fig. 2 Extraction yield of Dyes Sappang Wood

The yield of the dry extract

The weight of The Sappang wood extraction yield on concentrations of ethanol and temperatures were obtained can be seen in the table and figure below.

Table 2 Extraction yield of Sappang Wood Dyes

Treatment	Sample weight (gram)	Dyes weight (gram)	Yield (%)
A_1B_1	8.0016	0.5284	6.60
A_1B_2	8.0035	0.5557	6.94
A_1B_3	8.0008	0.5786	7.23
A_2B_1	8.0008	0.6919	8.65
A_2B_2	8.0023	0.7161	8.95
A_2B_3	8.0037	0.7262	9.07
A_3B_1	8.001	0.732	9.15
A_3B_2	8.0031	0.7399	9.25
A_3B_3	8.0025	0.7419	9.27

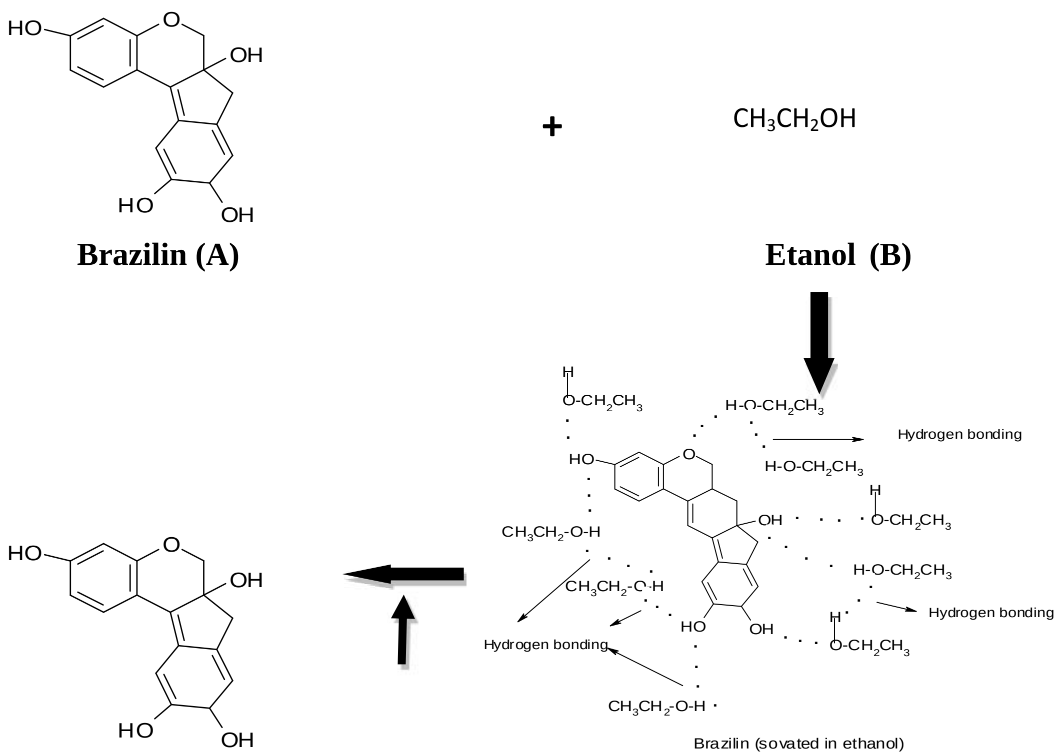
A_1B_1 : Concentration 70% and Temperature $60^{O}C$
A_1B_2 : Concentration 70% and Temperature $70^{O}C$
A_1B_3 : Concentration 70% and Temperature $80^{O}C$
A_2B_1 : Concentration 80% and Temperature $60^{O}C$
A_2B_2 : Concentration 80% and Temperature $70^{O}C$
A_2B_3 : Concentration 80% and Temperature $80^{O}C$
A_3B_1 : Concentration 90% and Temperature $60^{O}C$
A_3B_2 : Concentration 90% and Temperature $70^{O}C$
A_3B_3 : Concentration 90% and Temperature $80^{O}C$

Based on the calculation of the yield of sappang wood dyes extraction. The lowest yield is obtained at the concentration of 70%, and Temperature of 60 ^{0}C while the highest yield was obtained at a concentration of 90% and a temperature of 80 ° C.

The extraction of dyes in in figure 1 showed the yield of dye extract each variable temperature and solvent concentration, the greater the temperature and the concentration of the ethanol extraction results are also getting bigger, this is due to the increase in temperature and the concentration will lead to the more rapid movement of solvent molecules and so that collisions between random samples of solids and solvent molecules would be more likely to occur and this is causing a reaction or extraction process will be more likely to occur anyway (Supardi, 2008).

Mechanism and Calculation of the reaction rate on sappang wood extraction

Extraction mechanism of Sappang Wood dyes can be seen in figure 3. Brazilin (A) dye contained in sappang wood dye extracted by using ethanol (B), then brazilin solvated in ethanol, ethanol distilled in order to obtain the dye brazilin (C).



Brazilin (c) **Brazilin solvated in ethanol**

Fig. 3 Extraction mechanism of Sappang Wood Dyes by using ethanol

Results of Sappang Wood dyes extraction will be counted its reaction speed. The highest yield of Sappang wood extraction was calculated reaction speed. Calculation of the reaction rate is as follows:

$V = k (A)^x (B)^y$

V = reaction rate
K = reaction rate constant
X = orde reaction A
Y = orde reaction B
A and B = reactants

Data :
1) Sample weight : 8.0025 gram Mr $C_{16}H_{14}O_5$: 286 gr/mol

2) The extract weight : 0.7419 gram   Mr C_2H_5OH : 46 gr/mol
3) Extraction Yield : 9.27 %   Mr $C_{18}H_{18}O_5$: 314 gr/mol
4) Volume of ethanol : 175 ml = 0.175 L
5) Volume of extract : 150 ml = 0.15 L
6) Concentration of ethanol : 90 %
7) Temperature of extraction : 80^oC
8) Time of extraction : 2 jam = 7200 detik
9) Mol $C_{16}H_{14}O_5$: 0.028 mol
10) Molaritas C_2H_5OH (Zat B) : $\frac{B \ x \% x 1}{M}$

: $\frac{0.7 \ \frac{g}{m} x 9 \ \% x 1 \ \ m}{4 \ g \ /m}$

: 15.44 mol/L
11) Mol C_2H_5OH : Molar x Liter

: 15.44 mol/L x 0.175 L = 2.702 mol
12) Mol $C_{16}H_{14}O_5$: 0.7419 gr/ 286 gr/mol =0.0026 mol

13) Molaritas $C_{16}H_{14}O_5$ (Zat A) : mol/liter

: 0.028 mol / 0.175 liter

: 0.16 mol / liter

Having known each mole then searched the value of k (reaction rate constant) as shown below:

$$k = \frac{V(\quad (p \quad)}{m \quad (p \quad)x \ s}$$

$$k = \frac{0.15 \ L}{0.0026 \ m \quad x \ 7200 \ d}$$

K = 8.01 10^{-3} liter mol $detik^{-1}$

Having known the value of k (reaction rate constant) the reaction speed can be calculated as shown below.

$V = k (A)^x (B)^y$

V = 8.01 10^{-3} liter /mol detik (0.16 mol / liter) (15.44mol/liter)

V = 3.24 10^{-3} mol $liter^{-1}$ $detik\text{-}^{1}$

Dari perhitungan diatas diperoleh kecepatan reaksi pada suhu 80^oC dan konsentrasi 90% adalah 3.24 10^{-3} mol $liter^{-1}$ $detik\text{-}^{1}$

From the calculation above, The reaction rate of extraction of sappang Wood dyes is obtained at a temperature of 80 ° C and concentration of 90% is 3,24 10^{-3} mol /Liter second.

Conclusion

The Sappang wood dye can extracted with ethanol, the higher the temperature and the concentration of ethanol, the higher the percentage weight of dry extract Sappang wood dyes produced, and the highest extraction results obtained at a temperature of 80 ° C and concentration of 90% by weight of dry extract highest 0.7419 gram and percentage is 9.27% and reaction speed is 3:24 10^{-3} mol liter^{1} sec^{-1}.

REFRENCES

Holinesti R. 2009. *Studi pemanfaatan pigmen brazilein kayu secang sebagai pewarna alami sertabilitasnya pada model pangan*. J. Pend. Dan Keluarga UNP 1(2): 11-22.

Marwati S. 2012. Ekstraksi dan Preparasi Zat Warna Alami Sebagai Indikator.*Prosiding Seminar Nasional, Pendidikan dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta,* 14 Mei 2011.

Pratikto E. 2003. *Kimia Zat Warna.* Tangerang : Fakultas Teknik Kimia Tekstil Universitas Tangerang.

Prayitno, Endro K, Nurimaniwati. 2003. Proses Ekstraksi Bahan Pewarna Alami dari Limbah Kayu Mahoni. *Prosiding Pertemuan dan presentasi Ilmiah Penelitian Dasar Ilmu Pengetahuan dan Teknologi Nuklir,* P3TN-BATAN Yogyakarta, 8 juli 2003.

Ramadhan AE, Phaza HA. 2010. *Pengaruh Konsentrasi Etanol, Suhu, dan Jumlah Stage pada Ekstraksi Eleoresin Jahe (Zingiber officinale Rose) Secara Bath.* Jurusan Teknik Kimia Fakultas Teknik Undip. Semarang.

Regina, Siti, Antuni. 2012. Karakter zat warna kayu secang (*Caesalpinia Sappang L*) sebagai indikator asam basa.*Prosiding Seminar Nasional, Pendidikan dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta,*2 juni 2012.

Sanusi M. 1989. *Isolasi dan identifikasi zat warna kayuSappang*. Balai Industri Ujung Pandang. Moon, C.K., K.S. Park, S.G. Kim, and H.S. Won. 1992. Drug andchemical toxicology. Drug Chem. Toxicol. 15(1): 81−91.

Suryani. 2013. *Ekstraksi Zat Warna Kayu Sappang (Caesalpinia sappan L) Sebagai Indikator Asam Basa.* Prosiding Penelitian Dosen *ATIM.*

MISCONCEPTION RESISTANT LOADAND INPUT DIMENSION OFSTUDENT'SLEARNING STYLES ON CHEMICAL EQUILIBRIUM CONTENT

Septyadi David Eka Aryungga

Program StudyMagister Chemistry Education, Post Graduated, State University of Malang

Email: aryungga@gmail.com

ABSTRACT

The purpose of this research was to determine the relationship of misconception resistant loadand input dimension of student's learning styles on chemical equilibrium content. This research was a quantitative research using the ex post facto. The targets of this research is the students who have misconception resistant on chemical equilibrium content in SMAN 1 Kandangan, Kediri and SMAN 1 Sumenep identified conception by Certainty of Response Index (CRI) method. From 197 students, 97 students identified misconceptions resistant. Students who have misconceptions resistant administered tests of learning style on the dimension Input according to Felder and Silvermen. Misconception resistant load is categorized into three levels: low, medium, and high. The categorizing use central tendency (mean) of 6.80% and a standard deviation (standard deviation) of 4.44%. Identification ofthe student's learning styles using instruments adopted from Felder and Silverman and analyzed with their scale. The conclusions that can be drawn from this research is on the chemical equilibrium content (1) the number of students who have misconception resistant are vary, (2) misconception resistant loadand learning styles on the input dimensionare vary, and (3) the student's learning styles on the input dimension does not signifiacantlyaffect their misconception resistant load.

Keywords: misconception resistantload, input dimensional of learning style.

BACKGROUND

According to Sen (2012) and Abosalem (2013), there is a significant relationship between student's learning styles and misconception students. Aryungga (2014) on the results of the research found a significant relationship between student's misconception resistant andlearning styles of students on the input dimension.It shows that one of the causes of misconception thatdifficult to repair are internal factors or from the students themselves. Dunn (1995) argues that students who have a learning style that suits the teaching style tend to store information longer, apply it more effectively, and have the attitude after learning more positive towards subjects than students who experience learning style mismatch with the teaching style.

The hope after the learning activities is students do not havemisconception load. However, preventing and repairing misconception efforts of the still leaves some students who have misconception. Some researchers found that there are still who hawe misconception at the end of the program of remediation, among others, (1) Subagyo (2014) students who misconceptions remain 9%, (2) Hastuti (2014) students who misconceptions remain 3%, (3) Hono (2014) students misconceptions remain 23%. Based on these results, some students were found have misconception resistant. Expressed the misconceptionresistant student are those before prevention, after prevention and after remediation of misconceptions. It shows that correct misconceptions of the students is difficult (Effendy, 2002 and Barke, 2009). Therefore, it is necessary to research misconception resistant load of the students and learning styles on the input dimension.

RESEARCH METHODS

This research was a quantitative research using the ex post facto. The targets of this research is the students who have misconceptions resistant on chemical equilibrium content in SMAN 1 Kandangan, Kediri and SMAN 1 Sumenep identified conception by Certainty of Response Index (CRI) method. From 197 students, 97 students identified misconceptions resistant. Students who have misconceptions resistant administered tests of learning style on the dimension Input according to Felder and Silvermen.

Misconception resistant load categorized into three levels: low, medium, and high. The categorizing use central tendency (mean) of 6.80% and a standard deviation (standard deviation) of 4.44%. Categorizing misconception resistant load students can be presented in Table 1.

Table 1 Category ResistantMisconception Load Students

No	Range Value	Category
1.	More than 6.80%	High
2.	Between 4.44% - 6.80%	Medium
3.	Less than 4.44%	Low

Identification the learning styles using instruments adopted Felder and Silverman and analyzed withtheir scale as shown in Figure 1.

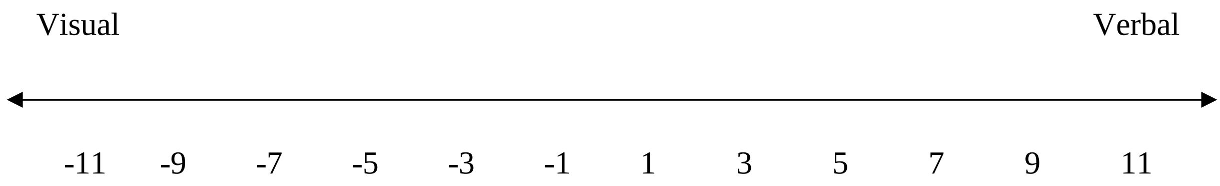
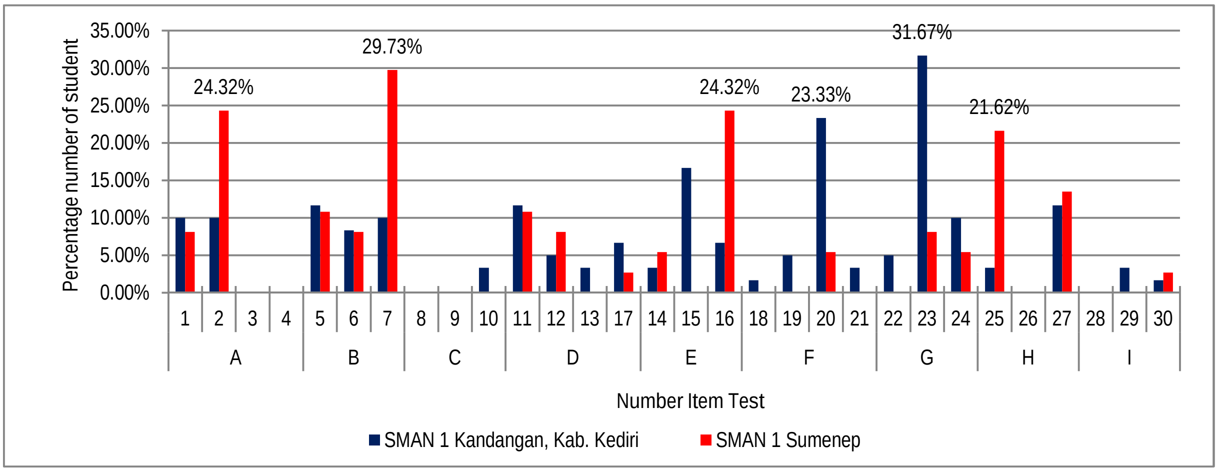


Figure 1 Scale Felder Learning Style on the Input Dimension

Results of student's learning style can be categorized into three, namely: (1) if the student scores on a scale of -3, -1, 1, and 3 in a second dimension, the learning styles it tend to be balanced, (2) if the student scores on a scale of -7, -5, 5, and 7 on a dimension, it tends to one of the learning style but is not so strong (medium), and (3) if the student scores on a scale of -11, -9, 9 and 11 on a dimension,it tends to one of the learning style and its highly dominant/strong (Felder, 1993).

RESULTS AND DISCUSSION

The results of identification students who have misconceptions resistant on chemical equilibrium content in SMAN 1 Kandangan, Kediri and SMAN 1 Sumenep are presented in Figure 2.



Concept Description:

A. Chemical equilibrium (definition)

B. The equilibrium constant (Kc)

C. Homogeneous and heterogeneous equilibria

D. The principle of shifting the equilibrium

E. Direction shifts the equilibrium by changes in concentration

F. Direction shifts the equilibrium by changes in pressure

G. Direction shifts the equilibrium by changes in temperature

H. Direction shifts the equilibrium by addition of a catalyst

I. Direction shifts the chemical equilibrium by changes in pressure or volume for the reaction with the amount of reaction coefficient

J. of left and right segments

Figure 2 Percentage Number of Students Who HadMisconception Resistance in Chemical Equilibrium Content.

Based on Figure 2 can be given the data analysis as follows:

1. In most of the concepts there are students who have misconception resistant.
2. The percentage of students who have highestmisconceptions resistant at SMAN 1 Kandangan, Kediri are in the concept of direction shifts the equilibrium by changes in temperature number 23 at 31.67%, whereas at SMAN 1 Sumenep on the concept of equilibrium constant (Kc) number 7 of 29 73%.

Based on the identification of misconceptions load resistance and the student's learning style on the dimension of input, the result can be presented in Figure 3.

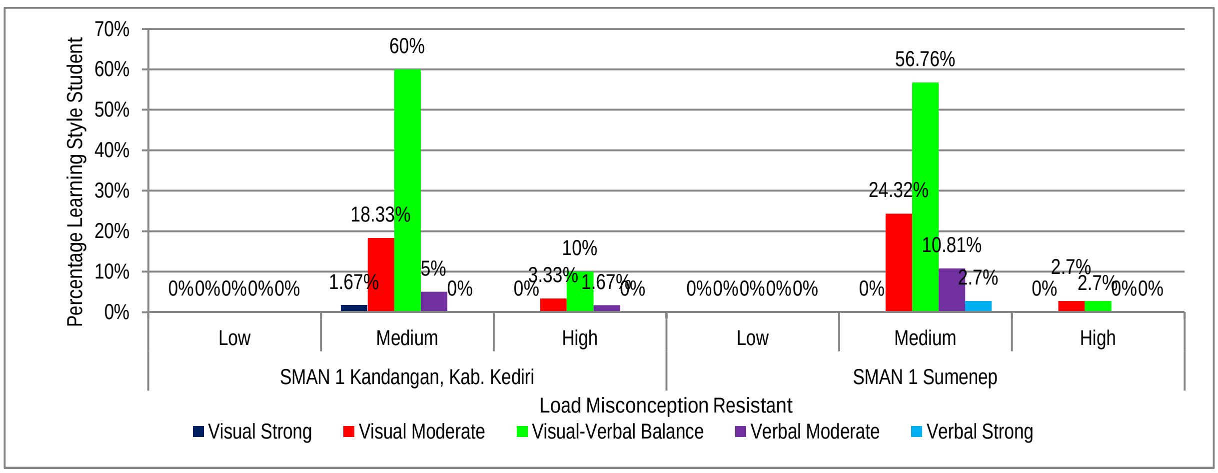


Figure 3 Percentage of Students Learning Style Who Have Misconception Resistant Based on Misconception ResistantLoadon Chemical Equilibrium Content.

The results of identification are presented in Figure 3, can be analyzed as follows:

1. Both schools showed that the majority of students who have resistant misconception loadare in the medium category. The students who have the misconception resistant load in the category at SMAN 1 Kandangan, Kediri are 85%, whereas at SMAN 1 Sumenep are 94.6%.
2. Learning style that dominates the students who have misconceptions resistant load in medium category has a majority of visual-verbal balanced learning style. The percentage of students who havemisconceptions resistant load medium category and

visual-verbal learning style balanced at SMAN 1 Kandangan, Kediri are 60%, whereas at SMAN 1 Sumenep are 56.76%.

3. If you see the number line shown as Figure 1, the visible area of student misconceptions resistant central area and rarely even there on the edge or tip.

Test results of chi-square (χ^2) to determine the relationship of the burden of resistant miskonsensi students with learning styles on the dimension of input, using SPSS results are presented in Table 2.

Table 2 Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	0.343[a]	4	0.987
Likelihood Ratio	0.566	4	0.967
Linear-by-Linear Association	0.024	1	0.877
N of Valid Cases	0.97		

Based on Table 2 P-value of 0.987 is bigger than $\alpha = 0.05$. This indicates that the H_0 is accepted. The conclusions is no significant relationship between load misconceptions resistance students with the learning styles of input dimension.

In this research, misconceptions resistant students spread throughout almost the concept, the percentage of students who have misconceptions resistant have diverse variations. It shows each student has a different learning speeds (Arifin, 1995). This is also demonstrated by the student's learning style that shows diverse variations. The diversity suggests that each student has distinct characteristics. The distinctiveness indicating each student requires special treatment in fixing misconception them.

The improvements of the learning process are termed by remedial learning/remediation. According to Mulyadi (2010), remedial learning is a form of learning that is healing or repair. Remediation in learning is not providing a similar matter to the students to work back. According to Suyono (2014), remediation learning is a specialized learning that individualized and its accordance with the characteristics of the students.

Based these conditions, the solutions offered to correct misconception of students is teachers should fix misconceptions of students based on their characteristics.

In this research, it is limited to the learning styles of input dimension. On their learning style, there are five types of learning styles, namely: visualstrong, visual moderate, visual-verbal balance, verbal moderate, and verbalstrong. The majority of students who have misconceptions is whose visual-verbal balanced learning style. According to Felder (2014) students who have that learning style tended to visual and verbal weakly. So, this does not mean that children can receive a good learning if the teacher explained with graphics and lectures,unlike the students who have learning style tendency a visual moderate, visualstrong, verbal moderate or verbal strong. They already have a dominant learning style so they will know how he will learn well. For example, a student who has a visual moderate learning style, he will initially see the animation (Felder and Silverman, 1988) which occurred in the process of microscopic-chemical equilibrium, but he would occasionally see the book to match with theory.

Based on the analysis using χ^2 test, The results there are the student's learning styles on the input dimension does not signifiacantly affect their misconception resistant load. It shows that the students' learning styles on the dimension of input do not affect how much students have misconceptions resistant. According toAryungga (2014) on the results of the research found a significant relationship between student's misconception resistant and learning styles of students on the input dimension. Based on these facts, it proves that the student's learning style can lead to students misconceptions are resistant, but it does not make how big the load of misconceptions resistant.

CLOSING

Conclusions

The conclusions of theresearch is on the chemical equilibrium content (1) the number of students who have misconception resistant are vary, (2) misconception resistant load and learning styles on the input dimensionare vary, and (3) the student's learning styles on the input dimension does not signifiacantly affect their misconception resistant load.

Suggestion

Repairing misconceptions of students is encouraged to do remediation individually based on their characteristics such as learning styles to the input dimension. For example, if students who have misconception resistant and visual learning style, experienced a misconception in the definition of chemical equilibrium, then the teacher should make representations with assisted animation media to describe the example chemical equilibriummicroscopic events.

REFERENCES

Abosalem, Y. M. 2013. “The Relationship Between the Learning Styles of Students in Grades Five and Six and Their Held Misconceptions About Dividing Fractions Based on Kolb’s Model.” *Thesis*.Dubai : The British University.

Arifin, M. 1995. *Pengembangan Program PengajaranBidangStudi Kimia*. Surabaya: Airlangga University Press.

Aryungga, S. D. E. and Suyono. 2014. “The Effect of Student’s Learning Style on Student Resistant Misconception in Chemistry Concept.” *ProceedingsICMSTEA 2014*. Makassar: UNM.

Barke, H.D., Al Hazari, and Yitbarek, S. 2009. *Misconceptions in Chemistry*. Berlin: Springer Link.

Dunn, R., Griggs, S. A., Olson, J., Gorman, B., and Beasley, M. 1995. “A meta-analytical validation of the Dunn and Dunn learning styles model.” *Journal of Educational Research*, Vol. 88, No. 6, Hal. 353-361.

Effendy. 2002. UpayauntukMengatasiKesalahanKonsepdalamPengajaran Kimia denganMenggunakanStrategiKonflikKognitif. *Media Komunikasi Kimia*, Vol. 6, No. 2, Hal. 1-22.

Felder, R. M. and Silverman, L. 1988. "Learning and Teaching Styles in Engineering Education.”*Engineering Education*.Hal.674-681.

Felder, R. M. 1993. "Reaching the Second Tier: Learning and Teaching Styles in College Science Education.”*J. College Science Teaching*, Vol. *2*, No. 5, Hal. 286-290.

Felder, R. M. (Rmfelder@mindspring.com). (2014, May 18). Re: David From Unesa, Surabaya, Indonesia. Email to recipients Septyadi David EkaAryungga (aryungga@gmail.com).

Hastuti, W. 2014.“PrevensidanReduksiMiskonsepsiSiswapadaKonsepReaksiRedoksMelaluiGabunganSekuensial Model *Modified Inquiry*dan*ECIRR*.”*Thesis*. Surabaya: Post GraduatedUnesa.

Hono, A. S. 2014. “PenerapanModel *Learning Cycle 7E* dan *ECIRR* untuk Mengatas iMiskonsepsi Siswa pada Konsep Reaks iRedoks.” *Thesis*. Surabaya: Post GraduatedUnesa

Mulyadi. 2010. *Diagnosis Kesulitan Belajar.* Yogyakarta: Nuhali Tera.

Sen, S. andYilmaz, A. 2012. “The effect of learning styles on students’ misconceptions and selfefficacy for learning and performance.” *Procedia - Social and Behavioral Sciences*, Vol. 46, Hal.1482-1486.

Subagyo, A. R. 2014. “Penerapan*Modified Inquiry Models* dan Strategi Analogi untuk Mengatas iMiskonsepsi Siswa Pada Konsep Kesetimbangan Kimia.”*Thesis*. Surabaya: Post GraduatedUnesa.

Suyono, Amaria, Muchlis, andSetiarso, P. 2014. “Diseminasi Model PrevensidanKurasiMiskonsepsiSiswapadaKonsep Kimia.”*FinalReport of College Reseach*. Surabaya: LPPM Unesa.

Minerals, Nutrients and Active Compounds of Rambutan Fruits

Sukemi
Education Faculty of Mulawarman University, Samarinda, 75123, Indonesia

ABSTRACT

The main objective of this essay was to describe the minerals, nutrients and active compounds of rambutan (*Nepheliumlappaceum* L.) fruits. Flesh fruit of rambutanis a sourceof minerals and ascorbic acid that are needed by human. Its seed oil provides mineral and fatty acid. Its peel contains ellagic acid, corilagin and geraniin that have biological activities, such as antioxidant, anticancer, anti-inflammation, anti-hyperalgesic antiviral, anti-semicarbazide-sensitive amine oxidase (SSAO), and anti-hypertensive. Rambutan is not only consumed as fresh fruits, but also it can be used as sources of food and medicine products.

Fruits and vegetables are common source of nutrients, minerals andbiologically active substances (Zimmermann, 2001; Dembistsky et al., 2011). Many plants including fruits have been reported that they contain active compounds,compounds have biological activities,and some of them have been isolated and identified (Dembistsky et al., 2011; Kusuma et al., 2011).Dembitsky et al. (2011) reported at least 20 fruits such as acai,acerola, avocado, dragon fruit, durian, graviola, guava, kiwano, kiwifruit, litchi, longan, mago, mangosteen, passiflora, persimmon, pineapple, snake fruit, star fruit, wax apple and rambutan,are rich of nutrients and minerals, andhave biological activities.Rambutan originated from Indonesia and Malaysia, even it has been cultivated in Southeast Asia, Srilanka, Australia, Central America, Equatorial Africa and Malagasy (O'Hare, 1995; Ong et al, 1998; Rukmana&Oesman, 2002).Its minerals and nutrition composition was evaluated, andsome of its active compounds that have antibacterial, antioxidant, antihyperglycemic activities,have been identified and isolated (Wong et al., 1998; Ong et al, 1998;Okonogi et al., 2007; Thitilertdecha et al., 2008; Palanisamy et al., 2008; Thitilertdecha et al., 2011, Solís-Fuentes et al., 2010; Palanisamy et al., 2011; Chan et al, 2012; Harahap et al., 2012; Bhat& Al-daihan, 2014).**Rambutan contains minerals and nutrition that useful for human, and chemical constituents that have biological activities.**

Rambutan contains minerals and nutrition that useful for human. Each 100 gram fresh fruits of edible portion of rambutan contains82.1 g water, 0.9 g protein, 0.3 g fat, 0.3 g ash, 2.8 g glucose, 3.0 g fructose, 9.9 g sucrose, 2.8 g dietary fiber, 0.05 g malic acid, 0.31

g citric acid, 297 kJ energy, 0.5 mg niacin, 15 mg calcium, 2.5 mg iron, 70 mg ascorbic acid, 0.01 mg thiamin, 0.07 riboflavin, 140 mg potassium, 2 mg sodium, and 10 mg magnesium (Tindal, 1994).The ascorbic acid and mineral of some species of rambutan that cultivated in Hawaii have been investigated by Wall (2006)that shown in table 1.If it is compared with data of Dietary of Reference Intake (DRI) that shown in table 2, consumption of about 157-350 g and 188-401 g edible parts of rambutan would comply the daily ascorbic acid requirements for the adult females and males. 100 g of fresh rambutan can supply about 2%, 38%, 1%, 2.9% of the DRI for Phosphorus (P), Potassium (K),Calcium (Ca),Sodium (Na) both of adult females and males, and 3.9% and 5.2% of DRI forMagnesium (Mg) of adult females and males.Seed of rambutan contains 38.9% fat, 12.4% protein and 48.0% carbohydrate.The seed is the potential sources of seed oil. Concentrate of fat inrambutan seed oil is the highest if compared with fat in sunflower oil (36%) and palm kernel oil (36%). It implies that rambutan seed oil is a potential source for fat/oil that can use in industry and for human consumption. The rambutan seed oil provides most of mineral for human requirements base on DRI standard. Concentration of Ca, Mg, Mn, Cu, Zn and Fe were 160.31, 51.01, 1.62, 0.83, 40.61 and 24.77 mg/100 g rambuatan seed oil. Fatty acids in rambutan seed oil are palmitic, palmitoleic, stearic, oleic, arachidic, gondoic and behenic acid(Harahap et al., 2012).

Table 1. Ascorbic acid and mineral composition of some species of rambutan (per 100 g edible tissue)

Nutritional and mineral (mg/100 gfw[a])	Species/ Location of cultivation[b]						
	R9	Jetlee	R162	Rongrien		R134	Silengkeng
	Kurtistown	Keaau	Keaau	Keaau	Pepeekeo	Pepeekeo	Pepeekeo
Ascorbic acid	22.0 ± 2.7	38.1 ± 1.3	47.8 ± 3.3	39.3 ± 2.3	37.6 ± 3.9	30.8 ± 1.6	39.1 ± 2.7
Phosphorus (P)	18.8 ± 0.8	17.6 ± 0.7	16.9 ± 1.8	17.1 ± 1.6	18.4 ± 1.0	17.8 ± 1.5	8.8 ± 1.6
Potassium (K)	174.8 ± 7.6	197.6 ± 15.7	249.4 ± 26.1	229.0 ± 25.4	134.5 ± 10.6	139.2 ± 14.5	133.5 ± 14.2
Calcium (Ca)	7.6 ± 0.6	6.8 ± 0.9	8.4 ± 0.7	8.7 ± 0.7	13.3 ± 0.6	8.6 ± 1.1	7.7 ± 0.7
Magnesium (Mg)	15.4 ± 0.5	16.6 ± 0.4	17.2 ± 1.3	16.6 ± 1.9	16.6 ± 0.4	16.3 ± 1.1	16.7 ± 1.6
Sodium (Na)	6.3 ± 0.6	5.7 ± 0.8	8.2 ± 1.2	6.5 ± 0.8	5.7 ± 0.6	6.2 ± 0.8	5.5 ± 0.5
Iron (Fe)	0.50 ±	0.49 ±	0.44 ±	0.53 ±	0.41 ±	0.42 ±	0.56 ±

	0.05	0.10	0.02	0.04	0.04	0.04	0.07
Manganese (Mn)	0.11 ± 0.01	0.38 ± 0.18	0.30 ± 0.07	0.19 ± 0.03	0.07 ± 0.01	0.16 ± 0.02	0.12 ± 0.02
Zinc (Zn)	0.26 ± 0.01	0.20 ± 0.01	0.22 ± 0.02	0.21 ± 0.01	0.23 ± 0.01	0.16 ± 0.01	0.18 ± 0.02
Copper (Cu)	0.18 ± 0.01	0.17 ± 0.01	0.17 ± 0.02	0.17 ± 0.02	0.20 ± 0.01	0.18 ± 0.02	0.16 ± 0.01
Boron (B)	0.12 ± 0.01	0.11 ± 0.01	0.16 ± 0.01	0.14 ± 0.01	0.13 ± 0.01	0.13 ± 0.01	0.13 ± 0.01

[a] gram fresh weight

[b] some areas in Hawaii

Table 2.DRI of mineral (mg/day)

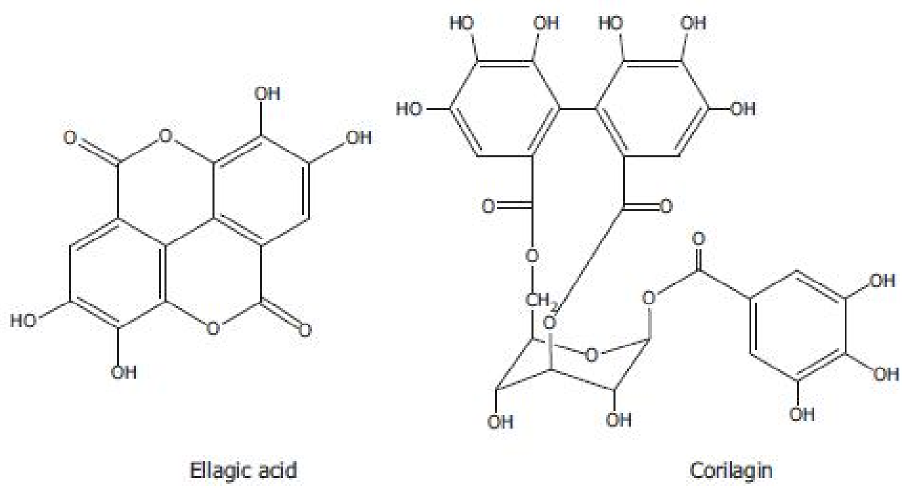
Nutritional and mineral	Ascorbic Acid	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu	B
DRI (mg/day)	75, 90[b]	700[a]	4700[a]	1000[a]	320, 420[a]	1500[a]	18, 8[a]	1.8, 2.3[a]	8, 11[a]	0.9[a]	ND

[a] Dietary reference intakes (DRI) are the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine (IOM) (2000a, 2001, 2004). Values given are for adult females and males, ages 19–50 years. For boron, ND = not determinable.

[b]Dietary Reference Intakes (DRI) established by the Food and Nutrition Board of the Institute of Medicine, National Academy of Sciences (2000b). Values given are for adult females and males, ages 19–50 years.

Secondary metabolites in rambutan are responsible in its biological activities. They are ellagic acid, corilagin and geraniin (Thitilertdechaer al., 2010). ***Ellagicacid***can be used as supplement for diabetic cardiomyophaty and acts as antioxidant and anticancer. Several researches on ellagic acid have been done. Chao, et al. (2009) stated that ellagic acid, together with caffeic acid, can provide triglyceride-lowering, anti-coagulatory, anti-oxidative, and anti-inflammatory protection in cardiac tissue. They concluded the supplement of both ellagic acid and caffeic acid may help to prevent or alleviate diabetic cardiomyophaty, a disorder of heart muscle in human with diabetes. Other research has been done by Thitilertdecha et al. (2010) and they reported that ellagic acid, with corilagin and geraniin, isolated from *N. lappaceum*rind is higher than BHT for antioxidant activity. In 2013, Zhao et al. did research and its result shows that the ellagic acid can inhibit the growth of pancreatic cancer. In the same year, Faravin et al. concluded in their research that ellagic acid will be an alternative treatment in the future to reduce inflammation that caused by acute lung injury (ALI), a disease characterized by damaging in lung tissue, and others inflammatory diseases.

Corilagin has biological activities as anti-inflammation andanti-hyperalgesic.Guo et al. (2010) investigated ability ofcorilaginas anti-inflammation against herpes simplex virus (HSV)-1, a virusthat causes herpes disease. Corigalin impedes HSV-induced via microglia, are type of glial cell that is immune cell in central nervous system. They added that corilagin had effect as well as dexamethasone, a drug that has anti-inflammatory effects, to avertdamage of brain after HSV infection.At the end they concluded that corilagin may be used as a strong effective agent for treating viral encephalitis. Moreira et al. (2013) in their research stated that corilagin that extracted from *Phyllanthusniruri* can act as anti-hyperalgesic.



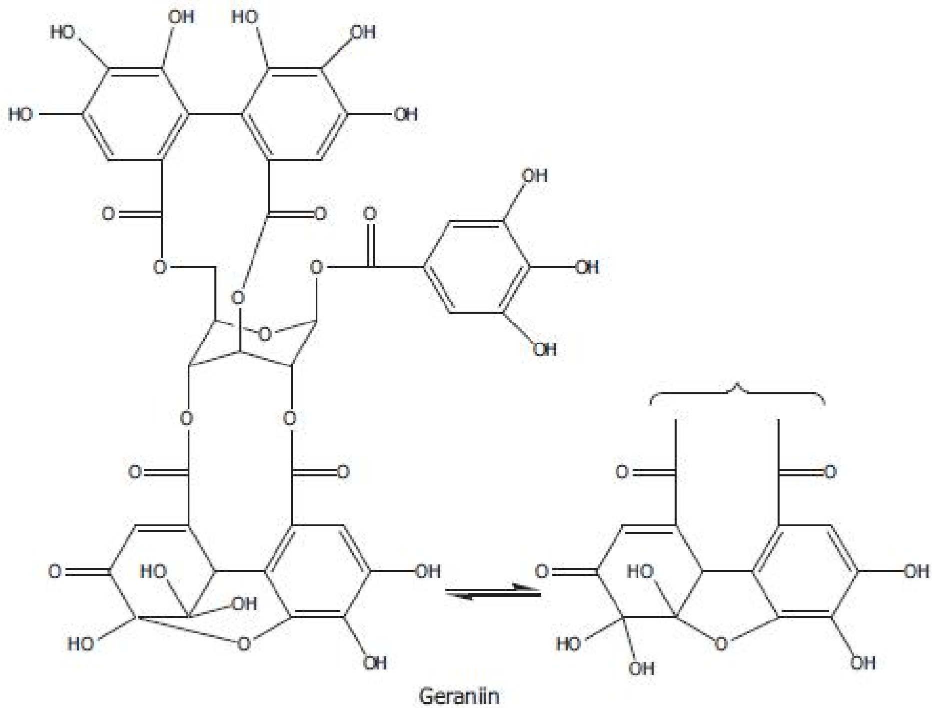


Fig. 2 the structure of ellagic acid, corilagin and geraniin

Geraniin is used as antioxidant, antiviral, anti-semicarbazide-sensitive amine oxidase (SSAO), and anti-hypertensive. This compound was the highest compound that have been isolated fromrambutan peel and together with ellagic acid and corigalin, exhibited better antioxidant activities than BHT in lipid peroxidation and DPPH assay (Thitilertdechaer al., 2010). Compared with of 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), an antioxidant, cytoprotective activity of geraniin is better (Ling et al., 2012). Ten µg/ml of geraniin successfully prevented 50% replication of enterovirus71, a virus causes diseases on hand, feet and mouth of children under 6 years of age, in rhabdomyosarcoma cells (Yang et al., 2012). A similar study conducted by Lin et al. (2008) on isolate of geraniin from *Phyllanthusurinaria* and they concluded that it has activities as antioxidant, SSAO inhibitory and antihypertensive. Boomsma et al. (2000) in Lin et al. (2008) stated that "SSAO is the common name for a group of heterogeneous enzymes widely distributed in nature, in plants, microorganisms, and the organs of mammals". Plasma SSAO was spread in diabetes mellitus and heart failure (Lin et al., 2008). Further Lin et al. concluded that geraniin can be used as antioxidant protection and therapeutic effect in healthy food products.

In brief, flesh and seed of rambutanprovide minerals and nutrition that needed by human. Even the peel of rambutan contains secondary metabolites, such as ellagic acid, geraniin, and corilagin that known have biological activities such as antioxidant, anticancer, anti-inflammation, anti-hyperalgesic, antiviral, anti-semicarbazide-sensitive amine oxidase

(SSAO), and anti-hypertensive. It means,rambutanis not only consumed as fresh fruits, but also it can be used as sources of food and medicine products.

REFERENCES

Bhat, R.S., and Al-daihan, S. 2014, "Antimicrobial Activity of *Litchi chinensis* and *Nepheliumlappaceum*Aqueous Seed Extracts Against Some Pathogenic Bacterial Strains", **Journal of King Saud University – Science**,Vol. 26, No. 01, pp. 79-82.

Chan, C.K., Goh, B.H., Kamarudin, M.N.A., Kadir, H.A., 2012, "Aqueous Fraction of *Nepheliumramboutan-ake* Induces Mithocondrial-Mediated Apoptosis in HT-29 Human Colorectal Adenocarcinoma Cells", **Molecules**,Vol. 17, No. 6, pp. 6633-6657.

Chao, P., Hsu, C., Yin, M., 2009, "Anti-inflammatory and Anti-coagulatoryActivities of Caffeic Acid and Ellagic Acid in Cardiac Tissue of Diabetic Mice", **Nutrition & Metabolism**, 2009, Vol. 6 No. 33pp. 79-82, Online,http://www.nutritionandmetabolism.com/content/6/1/33 [2014, April 6].

Dembitsky, V.M., Poovarodom, S., Leontowicz, H., Leontowicz, M., Vearasilp, S., Trakhtenberg, S., Gorinstein, S., 2011, "The Multiple Nutrition Properties of Some Exotic Fruits: Biological Activity and Active Metabolites", **Food Research International**, Vol. 44, No. 7, pp. 1671-1701.

Favarin, D.C., Teixeira, M.M., de Andrade, E.L., Alves, C.d.E., Chica, J.E.L., Sorgi, C.A., Faccioli, L.H., Rogerio, A.P., 2013, "Anti-Inflammatory Effects of Ellagic Acid on Acute Lung Injury Induced by Acid in Mice", **Mediators of Inflammation,** Vol. 2013, No. 00, pp. 1-13, Online, http://www.hindawi.com/journals/mi/2013/164202/ [2014, April 6].

Guo, Y.J., Zhao, L., Li, X.F., Mei, Y.W., Zhang, S.L., Tao, J.Y., Zhou, Y., Dong, J.H., 2010, "Effect of Corilagin on Anti-inflammation in HSV-1 Encephalitis and HSV-1Infected Microglias", **European Journal of Pharmacology**, Vol. 635, No. 1-3, pp. 79-86.

Harahap, S.N., Ramli, N., Vafaei, N., Said, M., 2012, 'Physicochemical and Nutritional Composition of RambutanAnakSekolah (*Nepheliumlappaceum* L.) Seed and Seed Oil", **Pakistan Journal of Nutrition**, Vol. 11, No. 11, pp. 1073-1077.

Kusuma, I.W., Kuspradini, H., Arung, E.T., Aryani, F., Min, Y.H., Kim, J.S., Kim, Y.U., 2011, "Biological Activity and Phytochemical Analysis of Three Indonesian Medicinal Plants, *Murrayakoenigii*, *Syzygiumpolyanthum*and *ZingiberPurpurea"*,**Journal of Acupuncture and Meridian Studies**, Vol. 04, No. 01, pp. 75−79.

Lin, S.C., Wang, C.C, Lu, Y.L., Wu, W.C., Hou, W.C., 2008, "Antioxidant, Anti-semicarbazide-sensitive Amine Oxidase, and Anti-hypertensive Activities of

Geraniin Isolated from *Phyllanthusurinaria*, **Food and Chmeical Toxicology**, Vol. 46, No. 07, pp. 2485–2492.

Ling, L.T., Saito, Y., Palanisamy, U.D., Cheng, H.M., Noguchi, N., 2012, “Cytoprotective Effects of GeraniinAgaintsPeroxynitrite- and Peroxylradical-induced Cell Death Via Free Radical Scavenging Activity”, **Food Chemistry**, Vol. 46, No. 07, pp. 1899-1907.

Moreira, J., Klein-Júnior, L.C., Filho, V.C., Buzzi, F.C., 2013, “Anti-hyperalgesicActivity ofCorilagin,A Tannin Isolated from *Phyllanthusniruri*L. (Euphorbiaceae)”, **Journal of Ethnopharmacology**, Vol. 132, No. 04, pp.318–323.

Okonogi, S., Duangrat, C., Anuchpreeda, S., Tachakittirungrod, S., Chowwanapoonpohn, S., 2007, “Comparison of Antioxidant Capacities and Cytotoxicitiesof Certain Fruit Peels”**Food Chemistry**, Vol. 103, No. 03, pp. 839-846.

Ong, P.K.C., Acree, T.E., Lavin, E.H., 1998, [Abstract of “Characterization of Volatiles in Vol. 4, No. 1, ppRambutan Fruit (Nepheliumlappaceum L.)”, **Journal of Agricultural and Food Chemistry**, Vol. 46, No. 2, pp. 611-615] Available: Scopus [2014, January 20].

Palanisamy, U., Ming, C.H., Masilamani, T., Subramaniam, T., Teng, L.L., Radhakrishnan, A.K., 2008, “Rind of The Rambutan, *Nepheliumlappaceum*, A Potential Source of Natural Antioxidants”, **Food Chemistry**, Vol. 109, No. 01, pp. 54–63.

Palanisamy, U., Manaharan, T.,Teng, L.L., Radhakrishnan, A.K.C., Subramaniam, T., Masilamani, T., 2011, “Rambutan Rind in The Management of Hyperglycemia”, **Food Research International**,Vol. 04, No. 07, pp. 2278-2282.

Rukmana, R., and Oesman, Y.Y., 2012, **Rambutan: KomoditasunggulandanProspekBisnis**, 7th ed., Kanisius, Jakarta, p. 15.

Solís-Fuentes, J.A., Camey-Ortíz, G., Hernández-Medel, M.D.R., Pérez-Mendoza, F., Durán-de-Bazúa, C., 2010, “Composition, Phase Behavior and Thermal Stability of Natural Edible Fat from Rambutan(*Nepheliumlappaceum* L.)seed”, **Bioresource Technology**, Vol. 101, No. 02, pp. 799–803.

Thitilertdecha, N., Teerawutgulrag, A., Rakariyatham, N., 2008, “Antioxidant and Antibacterial Activities of *Nepheliumlappaceum* L. Extracts”, **LWT - Food Science and Technology**,Vol. 41, No. 10, pp. 2029-2035.

Thitilertdecha, N., Teerawutgulrag, A., Kilburn, J.D., Rakariyatham, N, 2010, [Abstract of “Identification of Major Phenolic Compounds From *Nepheliumlappaceum L.* and Their Antioxidant Activities”, **Molecules**, Vol. 15. No. 3, pp. 1453-1465] Available: Scopus [2014, March 21].

Thitilertdecha, N., Rakariyatham, N., 2011 “Phenolic Content and Free Radical Scavenging Activities in Rambutan during Fruit Maturation”, **ScientiaHorticulturae,** Vol. 129, No.2, pp. 247–252.

Tindal, H.D., 1994, **Rambutan Cultivation**, Food and Agriculture Organization of the United Nation, Rome, p. 12.

Uji, T., 2007, "Species Diversity of Indigenous Fruits in Indonesia and Its Potential" **Biodiversitas**, Vol. 8, No. 2, pp. 157-167. (inBahasa Indonesia).

Wall, M.M., 2006, "Ascorbic Acid and Mineral Composition of Longan(*Dimocarpuslongan*), Lychee (*Litchi chinensis*) and Rambutan(*Nepheliumlappaceum*) Cultivars Grown in Hawaii", **Journalof Food Composition and Analysis**,Vol. 09, No. 6-7, pp. 655–663.

Wong, K.C., Wong, S.N., Loi, H.K., Lim, C.L., 1998, [Abstract of "Volatile Constituents from The Fruits of Four Edible Sapindaceae: Rambutan (*Nepheliumlappaceum* L.), Pulasan (*N. ramboutan-ake* (Labill.) Leenh.), longan (*Dimocarpuslongan*Lour), and Mata Kucing (*D. longan spp. malesianus*Leenh.), **Flavour and Fragrance Journal**, Vol. 11, No. 4, pp. 223-229] Available: Scopus [2014, January 17].

Yang, Y., Zhang, L., Fan, X., Qin, C., Liu, J., 2012, "Antiviral Effect of Geraniin on Human Enterovirus 71 in Vitro and in Vivo", **Bioorganic & Medicinal Chemistry Letters**, Vol. 22, No. 06, pp. 2209–2211.

Zhao, Y.X., Liang, W.J., Fan, H.J., Ma, Q.Y., Tian, W.X., Dai, H.F., Jiang, H.Z., Li, N., Ma, X.F., 2011, "Fatty Acid Synthase Inhibitors from The Hulls of *Nepheliumlappaceum* L.", **Carbohydrate Research**, Vol. 346, No. 11, pp. 1302-1306.

Zhao, M., Tang, S.N., Marsh, J.L., Shankar, S., Srivastava, R.K., 2013, "Ellagic Acid Inhibits Human Pancreatic Cancer Growth in Balb C Nude Mice", **Cancer Letters**, Vol. 337, No. 02, pp.210-217.

Zimmermann, M., 2001, "Burgerstein's Handbook of Nutrition: Micronutrients in The Prevention and Therapy of Disease", Thieme, Germany, p. 13.

STRUCTURAL ELUCIDATION OF SECONDARY METABOLITES IN SPONGE (*Callyspongia pseudoreticulata*) WITH N-HEXANE EXTRACT

M. Nurdin

Chemistry Department of Mathematic and Natural Science Faculty, Makassar Islamic University, South Sulawesi, 90245, Indonesia

Phone: 082190945091, e-mail : nurdin.unhas@gmail.com

Hanapi Usman

Chemistry Department of Mathematic and Natural Science Faculty, Hasanuddin University,

South Sulawesi, 90245, Indonesia

Phone: 0411-586773, e-mail : hanapiu@yahoo.com

Ambo Ala

Cultivation Department, Faculty of Agriculture Hasanuddin University Makassar,

South Sulawesi, 90245, Indonesia

Phone: 0411-587069, e-mail : amboala_aa@yahoo.com

Baharuddin

Plant Pests and Diseases Department, Faculty of Agriculture, Hasanuddin University Makassar, South Sulawesi, 90245, Indonesia

Phone: 0411-587100, Fax. 0411587100, e-mail : baharunhas@yahoo.com

ABSTRACT

Sponge is one of marine that have high bioactivity and contain secondary metabobolite compaund which can be used as antibiotic and medicine. Terpenoid compound derivatives have been successfully isolated from sponge Callyspongia pseudoretilulata by a a method in which the n-hexane extract weighting 11.28 g was fractionated using vacuum column chromatography with a non-polar eluent, n-hexane. The polarity of this eluent was improved by ethyl acetic resulting in fairly polar eluent, methanol. Total 27 fractions were obtained and one of the compounds from n-hexane extract was structurally elucidated by NMR spectroscopy and two dimensions of homonuclear and heteronuclear (^{1}H, ^{13}C, DEPT, H-H COSY, HMQC, and HMBC). The identified compound was a hydrocarbon (1-ethyl cyclo hex cosana-1-amin) that indicated LC50 of 60.58 against *A. salina* and has a great potential as antitumor or anticancer.

Keywords: *Callyspongia pseudoreticulata*, n-hexane

1. Introduction.

Sponge is a rich source of terpenoid, peptide, polyketida, alkaloid, steroid, and other compounds. A study on cytotoxic secondary metabolites from sponge (1986-1991) suggested that the compounds had potential as antitumor (Schemitz et. al., 1993). Sponges live and distribute in various waters in islands and continents (Soest et. al., 1994) including in South Sulawesi water (Voogd and Soest, 2002). Sponges have various different species, numbering more than 10000 species in four classes: *Hexatinellidae*, *Calcarea*, *Demospongiae*, and *Sclerospongiae*. Demospongia class has the largest distribution (Barnes et. al., 1989).

This study was aimed to find out the toxicity of fractionated n-hexane extract of sponge (*Callyspongia pseudoreticulata*) against shrimp fries of *Artemua saliana*. This test was a secondary test with positive correlation to primary test of P388 cancerous cell and usually used as preliminary step in determining bioactive properties of an organic sample component. When the sample turns out to have bioactivity, further study is performed to elucidate the structure and tested for its benefit as pharmaceutical material (Anderson, et. al., 1991).

In the last decade, exploratory researches on sponge in South Sulawesi waters have been developed. In the waters there are many sponge types whose secondary metabolites are very potential as antiviral, antibacterial, and antifungal (Razak and Ridhay, 2004). This is in accordance to a study by Rusli (2005), who had successfully isolated and identified several secondary metabolites from various sponge derived from Samalona islands water, Makassar, and found to be bioactive against microbes. Other study on sponge *Xentospongia aschmorica* identified four manzamine A compounds, which were previously studied by many due to its potential as anticancer and its ability to inhibit malarial parasites (Sakai et. al., 1992).

The prevalent and commonly found sponges in Makassar waters are *Callyspongia* sp, and they are considered candidates for new pharmaceutical material discoveries. This species included *Callyspongia pseudoreticulata.* This sponge had been studied in an attempt to develop the prospect and benefit of secondary metabolite compounds, but still limited to the identification of their compound group (suriani, 2006).

According to Amir and Budianto (1996), the sponge *Callyspongia pseudoreticulata* is a commonly found sponge in Indonesia waters. This sponge is an oceanic biota that contains many secondary metabolite compounds. Isolates from this sponge have been identified containing some secondary metabolite compound groups such as terpenoid, alkaloid, and steroid.

In this research, we expect to know the bioactivity and secondary metabolites compound in *C. pseudoreticulate.* Remaining part of the paper is organized as follows: Section 2 describe the materials and the method. The result is discussed in Section 3. Section 4 is devoted to the summary and concluding remark.

2. Materials and Methods

2.1. Sample preparation and extraction

A survey was conducted before collecting the *Callyspongia pseudoreticulate* sample to determine the samples that met the pre-determined classification. Samples were collected from Samalona islands locations with 6 meter depth. The collected samples were then transferred to laboratory and reconfirmed for its classification. The samples were cleaned immediately by distilled water and then air-dried for 1 x 24 hours. After that, the samples were crushed with blender and then macerated with methanol for 2 x 24 hours four times. The macerates of methanol was evaporated in a low-pressure evaporator operated at 40^{o}C temperature to obtain concentrated macerates. The macerate was then extracted subsequently with n-hexane, chloroform, and ethylase.

The extraction was analyzed with C-NMR and H-NMR spectroscopy. C-NMR give the number of C atoms and H-NMR give the number of proton or hydrogen of the sample. .

2.2. Secondary Compounds Isolation

The n-hexane extract weighting 11.28 gram was fractionated using vacuum column chromatography with a non-polar eluent, n-hexane. The polarity of this eluent was improved by ethyl acetic resulting in fairly polar eluent, methanol and 27 fractions were obtained. The fractions were then analyzed by thin layer chromatography with eluent chloroform 100% and six primary fractions were obtained (Figure 1). Each of the primary fractions were further fractionated and then were crystallized and recrystallized to obtain first, second, and third compound. Compound 3 was a component in n-hexane extract. Thin-layer chromatography tests for third compound using three different eluent systems consistently revealed single spot, that the compound was considered as a pure compound. Combination of eluent and Rf value of compound 3 TLC can be seen in Table 1.

Table 1. TLC Chromatogram data for compound 3 and its Rf value

Eluent	**R_f**
n-hexane 100%	0,75
Chloroform : n-hexane = 1 : 9	0,95
Ethyl acetic : n-hexane = 1 : 9	0,97

3. Results and Discussion

The crystals obtained were solid white with melting point of 79-80°C. Liebermann Burchard test was negative for terpenoid or steroid. In the IR spectra of the compound 3 (Figure 1) the peak of 2960 and 2916 cm^{-1} represented -CH (*str*) of -CH2 and -CH3 groups. The peak at 1444 cm^{-1} represented -CH (*bending*). The peak at 3712 and 3757 cm^{-1} represented N-H (*str*) of NH2 group and 1083 cm^{-1} represented peak of C-N (*str*) (Figure 1).

NMR spectra data of compound 3 revealed 6 ^{13}C NMR signal at δc 32.12; 29.95; 29.89; 29.56; and 14.31 (Figure 2 and Table 2). Whereas the DEPT NMR 135 spectra data indicated 5 signals (Table 2). These signals represented 28 carbon atoms and interpreted as sp^3 group consisting of 1 quaternary carbon atom c 32.12 ppm, 1 methyl carbon atom c 14.31 ppm, and 26 methyl carbon atoms (Table 2). The ^{13}C NMR spectra data suggested a structure as described in Figure 3.

Table 2. ^{13}C NMR, DEPT NMR, ^{1}H NMR spectra data and H Integration of Compound 3.

No	δc NMR (ppm)	Group	H NMR (ppm) (multiplicity, J)	H integration (one)
1	32,12	-	-	-
2	29,95	H_2	1,65 2H (m)	2
3	29,89	H_2	1,20, (m)	50
4	29,56	H_2	1,20, (m)	2
5	22,89	H_2	1,20, (m)	2
6	14,31	H_3	0,85, 3H (t, 7,5 Hz)	3

Figure 1. IR spectra of Co

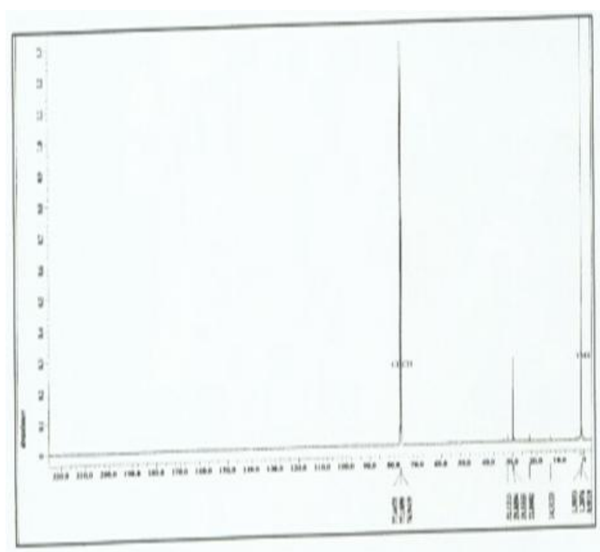


Figure 2. ^{13}C NMR spectra (compound 3)

No	c NMR (ppm)	δ_H NMR (ppm) (multiplicity, *J*)	H-H COSY	H-C HMBS
1	2,12	-		
2	29,95	1,65, 2H (m)	3	3,4,26
3	29,88	1,20, 2H (m)	2,4	2,4,5
4	29,88	1,20, 2H (m)	3,5	2,3,5,6
5	29,88	1,20, 2H (m)	4,6	3,4,6,7
6	29,88	1,20, 2H (m)	5,7	4,5,7,8
7	29,88	1,20, 2H (m)	6,8	5,6,8,9
8	29,88	1,20, 2H (m)	7,9	6,7,9,10
9	29,88	1,20, 2H (m)	8,10	7,8,10,11
10	29,88	1,20, 2H (m)	9,11	8,9,11,12
11	29,88	1,20, 2H (m)	10,12	9,10,12,13
12	9,88	1,20, 2H (m)	11,13	10,11,13,14
13	9,88	1,20, 2H (m)	12,14	11,12,14,15
14	9,88	1,20, 2H (m)	13,15	12,13,15,16
15	9,88	1,20, 2H (m)	14,16	13,14,16,17
16	9,88	1,20, 2H (m)	15,17	14,15,17,18
17	29,88	1,20, 2H (m)	16,18	15,16,18,19

18	29,88	1,20, 2H (m)	17,19	16,17,19,20
19	29,88	1,20, 2H (m)	18,20	17,18,20,21
20	29,88	1,20, 2H (m)	19,21	18,19,21,22
21	29,88	1,20, 2H (m)	20,22	19,20,22,23
22	29,88	1,20, 2H (m)	21,23	20,21,23,24
23	29,88	1,20, 2H (m)	22,24	21,22,24,25
24	29,88	1,20, 2H (m)	23,25	22,23,2,26
25	9,88	1,20, 2H (m)	24,26	23,24,26
26	29,88	1,20, 2H (m)	25	24,25,2
27	22,89	1,20, 2H (q, 7, 5 Hz)	2’	2’
28	14,31	0,85, 3H (t, 7, 5 Hz)	1’	1’

Table 3. ^{13}C NMR, ^{1}H NMR, H-H COSY and H-C HMBC data of Compound 3

1H NMR spectra data (Table 3) is in accordance to the suggested compound 3 structure (Figure 3). Proton shift at □H 0.85 ppm (3H, t, 7,5 Hz) represents H-2' and 1.20 ppm (2H, q, 7,5 Hz) represents H-1'. This structure became more apparent from H-H COSY spectra data. H-1' has a H-H COSY correlation to H-2' and H-3 to H2 and H-4, and H-4 to H-3 and H-5. H-H COSY correlation as a whole was indicated in Table 3. The next spectra data supporting the compound 3 structure was the H-C HMBC correlation. In Figure 3, the proton H-3 correlated to carbon atoms C-2 and C-4 in short distance and to C-5 in long distance. Whereas the proton H-25 correlated to C-24 and 26 in short distance and to C-23 in long distance.

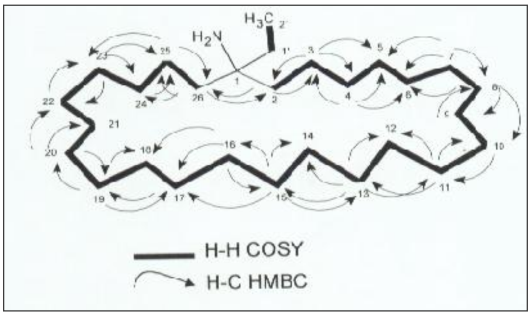


Figure 3. Structure of compound 3

4. Conclusion

One of the secondary compounds found in sponge *Callyspongia pseudoreticulata* with n-hexane extract was a hydrocarbon compound (1-ethyl cyclo hex cosana-1-amin). This isolated compound for the first time from sponge *Callyspongia pseudoreticulata* indicated LC50 of 60.58 against *A. salina* and has a great potential as antitumor or anticancer. It is a white crystal with 79-80^{o}C melting point.

Acknowledgments

The authors wish to thank Usman and Imran for valuable discussions. The research was performed using the facilities of Chemical Laboratory of FMIPA UNHAS Makassar and LIPI Serpong.

References

Achmad, S.A. 2004. Empat Puluh Tahun dalam Kimia Organik Bahan Alam Tumbuh-tumbuhan Tropika Indonesia, Rekoleksi dan Prospek. *Bulletin of the Indonesian Society of Natural Product Chemistry*. 4(2): 50-54.

Amir, I. dan Budianto, A. 1996. Mengenal Spons Laut (Demospongia) Secara Umum. *Oseana*. LIPI Jakarta. 21(2):15-30.

Anderson, J.E. Goeetz, C.M., McLaughlin. 1991. A. Blind Comparison of Simple Bench-top Bioassay and Human Tumor Cell Cytotoxicities as Antitumor Prescreen. *Journal Phytochemical Analysis*, V.2, 107-111.

Barnes, R, Calon, P., and Olive, P. 1989. *The Invertebrata*, Blackkywell Scientific Pub. Oxford, London, Endiburgh, Boston, Melborne, Five Pub: 49-53.

Endrada, R.U., Proksch, P., Wray, W., Witte, L., Mller, W.E.G., and Soest, R.W.M. van. 1996. Four New Bioactive Manzamine-Type Alkaloid from the Philippine Marine Sponge *Xestospongia aschmoica. Journal of Natural Product*. 59:1056-1060.

Irelend, C., Roll, D., Molnki, T., Mc Kee, T. and Swersey, J. 1988. *Uniqeness of the Marine Chemical Environment, Catagories of Marine Natural Products from Invertebrates in Biomedical Importance of Marine Organism*, Fautin, D.G., (ed), California Academy of Sciences, San Fransisco, 45-47.

Plisson, Fabien. 2014. Callyspongisines A–D: bromopyrrole alkaloids from an Australian marine sponge, *Callyspongia* sp. Org. Biomol. Chem. 1579 - 1584

Rahmaniar. 1992. Suatu Pengantar Oseana. *Toxin Marine*. 62(1):1-11.

Razak, A.R. dan Ridhay, A. 2004. *Penepisan Senyawa Anti Mikroba dari Beberapa Jenis Bunga Karang (Porifera*) *secara Kromtorafi Lapis Tipis Bioatografi*. Laporan Hasil Penelitian Nomor 89/P2IPT/DPPM/P10/III/2004. Kerjasama Departemen Pendidikan nasional dan Fakultas Keguruan dan Ilmu Pendidikan Universitas Tadulako.

Rusli, 2005. *Isolasi dan Identifikasi Senyawa Aktif Antimikroba Beberapa Spons dari Perairan Pulau Samalona*. Tesis tidak diterbitkan. Makassar: Program Pascasarjana Universitas Hasanuddin.

Sakai, R., Higa, T., and Jefoord, C. 1992. Manzamin A, A Novel Antitumor Alkaloid from a Sponge. *J. Am. Chem. Soc.*, 11(1):8925-8927.

San, T.W. 1993. Toxicity Testing Using The Brine Shrimp, *Artemia salina*, *Bioactive Natural Products, Detection, Isolation and Structural Determination*, Chi Press, Inc., London.

Satari, R. 2003. *Produk Bahan Alam Laut sebagai Lead Compound untuk Farmasi dan Pertanian*. Makalah disajikan dalam Seminar Sehari Prospektif Baru dalam Drug Discovery, Makassar, 26 Oktober 2003.

Schemitz, F.J., Bowden, B.F., and Toth, S.I. 1993. *Antitumour and Cytotoxic Compounds from Marine Organism, Pharmaceutical and Bioactive Natural Products*. New York: Plenum Press.

Soest, R.W.M. van. 1989. The Indonesian Sponges Fauna, A Status Report Netherlands, *Journal of Sea Research,* 23:223-230.

Soest, R.W.M. van, Kempen, T.M.G. van, and Breakman, J.C. 1994. *Sponges in Time and Space : Biology, Chemistry, Paleontology*. A.A Balkema/Rotterdam.

Suriani. 2006. *Isolasi, Karakterisasi, dan Uji Bioaktivitas Metabolit Sekunder Spon Callyspongia sp.* Tesis tidak diterbitkan. Makassar: Program Pascasarjana Universitas Hasanuddin.

Usman, H. 2005. *Isolasi, Karakterisasi, dan Uji Bioaktivitas Metabolit Sekunder dari Tumbuhan Cryptocarya costata*. Disertasi tidak diterbitkan. Makassar : Program Pascasarjana Universitas Hasanuddin.

Voodg, N.J. de and Soest, R.W.M.van. 2002. *Indonesian Sponges of Genus Petrosia Vormaer,* Amsterdam, University of Amsterdam.

Wiryowidagdo, S. dan Moka. W. 1995. *Identifikasi dan Eksplorasi organisme laut sebagai Sumber Bahan Obat Baru di Kepulauan Supermonde.*

Synthesis of Polyol As Lubricant Base

Via Epoxydation and Hydroxylation Reactions of *Moringa oleifera* Seed Oil

Ade Danova[1], Daniel Tarigan[2] dan Erwin[3]

Department of Chemistry, Faculty of Mathematics and Natural Sciences, Mulawarman University

Jl. Barong Tongkok, Kampus Gn.Kelua, Samarinda 75123, East Kalimantan

Email: danovaade@gmail.com

ABSTRACT

Moringa oleifera seed oil has potential as a base material in the synthesis of polyol, because the most content of fatty acid was oleic acid (up to70.7167%). Polyol could be used as a lubricant base. Polyol research of *Moringa oleifera* seed oil had been done via epoxidation and hydroxylation of one step reaction, where the polyol was characterizated by FT-IR spectroscopy shown absorption –OH group in the number of wave 3379.29 cm^{-1} and the number of iodine with iodometri methods that decreased from 107.3769 to 3.6755 mg I/g. Quality polyol test as a lubricant base consists of specific gravity (0,978), kinematic viscosity (216.702 cSt at 40^oC and 21.116 cSt at 100^oC) and viscosity index (111.013). Where they could be reported on the test results that the seeds of *Moringa oleifera* oil polyol was better than *Moringa oleifera* seed oil to use as a lubricant base, because it had committed with quality SAE J306 standards and classification SAE in manual gear oil, transmission and axle in lubricants group SAE 90 based to result from kinematic viscosity at 100^oC.

Keyword: *Moringa oleifera seed oil, polyol, lubricant base, SAE J306*.

1. Intoduction

Lubricating oil is used to lubricate the engine. The first specification of lubricating oil is high viscosity and stable, especially at high temperatures. Generally, lubricating oils have 20 to 60 chain of carbon. Currently, lubricating oils are used petroleum-based, so it is a non-renewable materials. Given the depletion of oil resources, should be considered to make lubricating oil from renewable materials for example of the methyl ester. Because chain of carbon in the constituent methyl ester compound is still too short, it is necessary to extend the chain of carbon treatment in order to meet the required viscosity and more stable by eliminating the carboxylic group and double bond [1].

Vegetable oils are considered an alternative to mineral oil as a lubricant base oil because of the technical nature of certain inherent and biodegradation. Vegetable oil with high oleic acid is considered to be the best alternative to replace conventional mineral oil as a lubricating oil and synthetic ester [2]. The epoxides can also be used as a high temperature lubricant and products are resulted from the opening of the ring can be used as a low-temperature lubricant [3].

In polymer chemistry, polyols are compounds to content of hydroxyl groups that can be used for other chemical reactions. A primary using of the polyol is as reactants to make polymers. The polyol may also be used for other purposes including in cosmetic formulations, lubricant and as a chemical intermediates [4].

One type of vegetable oil that have the potential to be developed as a lubricant base oil is the seed oil of *Moringa oleifera*. *Moringa oleifera* seed oil can be extracted by mechanical means or extracted with a solvent such as n-hexane. *Moringa oleifera* was contain 30% to 42% oil that comprised of fatty acid and oleic acid which was as high as 72.2% [5], 71,60% [6] and 78.59% [7].

This research is aimed to synthesis of polyol from *Moringa oleifera* seed oil as a lubricant base oil by reaction of epoxidation and hydroxylation and also to determine the quality of the physics and chemistry of the polyol was formed in its utilization as a lubricant base oil.

2. Materials and Methods

1.1 Materials

The materials are used in this research such as *Moringa oleifera*, n-Hexane, diethylether, glacial acetic acid (CH_3COOH), H_2O_2 30%, H_2SO_4 98%, Na_2SO_4 anhydrous and distilled water.

1.2 Methods

1.2.1 Extraction of *Moringa oleifera* Seed Oil

During the preparation step of raw materials in the first of *Moringa oleifera* seeds were peeled, dried and crushed. Then the next process was macerated, where samples have been refined put in a dark bottle and added n-hexane until the sample soaked . After that, the bottle was closed and allowed to stand for 2 x 24 hours while stirring. The extraction was filtered with filter paper and the filtrate on the rotary evaporation to get the *Moringa oleifera* seed oil. Identification of *Moringa oleifera* seed oil was done by volumetric analysis (iodine number) and FT-IR spectroscopy. The quality test of *Moringa oleifera* seed oil was done by the determination of specific gravity, kinematic viscosity and viscosity index.

1.2.2 Synthesis of Polyol

Into the flat bottom flask neck three was included as many as glacial acetic acid (CH_3COOH) 90 mL and added 30 mL of hydrogen peroxide (H_2O_2) 30% slowly while stirring with a magnetic stirrer. Through the dropper funnel was added H_2SO_4 2 mL while stirring with a magnetic stirrer at a temperature of 55-60 ° C for 1 hour. Furthermore, through a dropper funnel was slowly added *Moringa oleifera seed oil* 250 ml at a temperature of 10-15^{0}C. After all *Moringa oleifera* seed oil was added, then the temperature was increased at 55-60^{o}C while stirring for 4 hours, then the reaction product was left for one night. After that, a solution of the reaction product would be formed of two layers; the bottom layer was discarded and the upper layer was added diethyl ether. Diethyl ether layer was washed 3 times with distilled water, saturated NaHCO3 solution to pH neutral and distilled water 2 times. The results washing was dried with anhydrous Na_2SO_4 and then filtered. The filtrate was evaporated via rotary evaporator to obtain polyol *Moringa oleifera* seed oil as residue and analyzed by the determination of iodine number and FT-IR spectroscopy.

3. Results and Discussion

A total of 4,804 grams of *Moringa oleifera* seeds that had been finally put in a dark bottle, then soaked with solvent n-hexane and produce 1,389 grams of *Moringa oleifera* seed oil. So that the yield of *Moringa oleifera* seed oil was produced to amount 28.913%.

The contain fatty acid of *Moringa oleifera* seed oil was analyzed by using gas chromatography (GC), which chromatogram as follows:

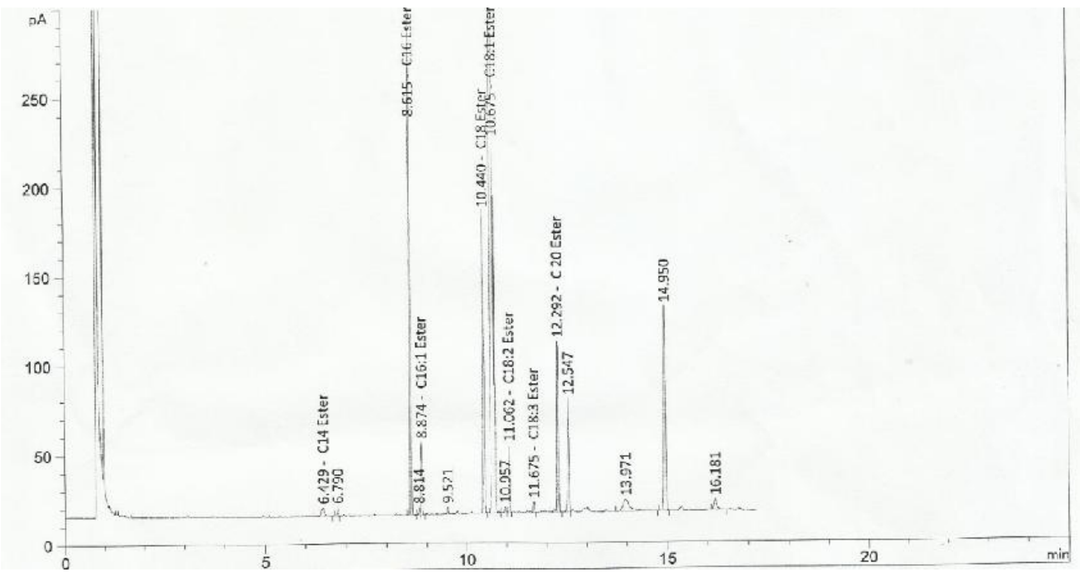
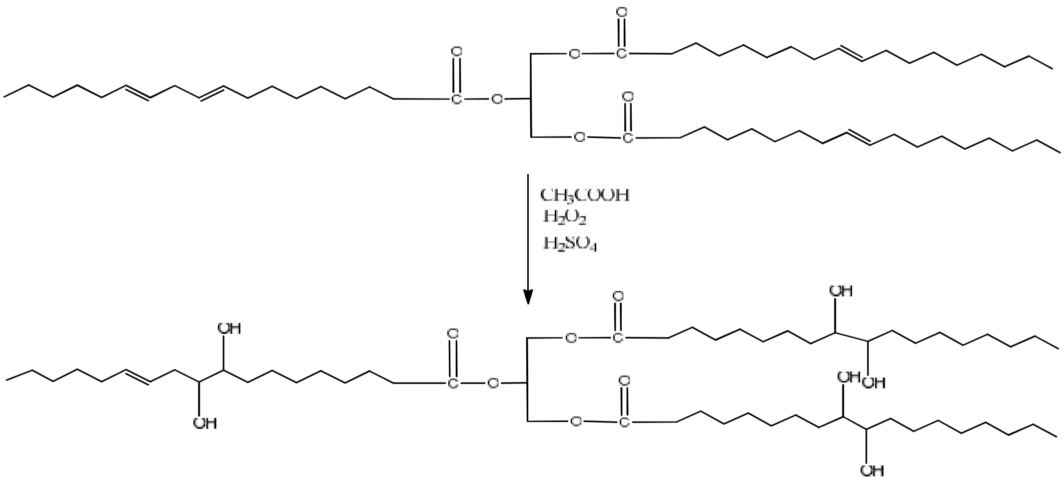


Figure.1 Chromatogram of Gas Chromatography from *Moringa oleifera* seed oil

From the chromatogram of the above showed that the *Moringa oleifera* seed oil contains two types of fatty acids based on double bonds were saturated fatty acids and unsaturated fatty acids.

1. Saturated fatty acids such as myristic acid 0.4444%, 7.2041% palmitic acid, stearic acid 5.2429%, 3.4183% arakhidat acid.
2. Unsaturated fatty acids such as acid palmitoleinat 1.0274%, 70.7167% oleic acid, linoleic acid 1.0065%, 0.1825% linolenic acid.

Polyol from *Moringa oleifera* seed oil was produced by reaction of epoxidation was the process of formation of oxiranes, where the *Moringa oleifera* seed oil were composed of triglycerides, double bonds contained in the oil was oxidized with an oxidizing, namely peracetic acid was produced by reacting acetic acid glacial (CH_3COOH) 100% with hydrogen peroxide (H_2O_2) 30%. Furthermore, the reaction was allowed to stand for one rnight and in the presence of glacial acetic acid which by product was enough for the opening of oxirane groups (hydrolysis) into polyols as a reaction scheme of the following steps:



Polyol from *Moringa oleifera* seed oil was produced, then analyzed by FT-IR spectroscopy and produced spectrum, as shown below:

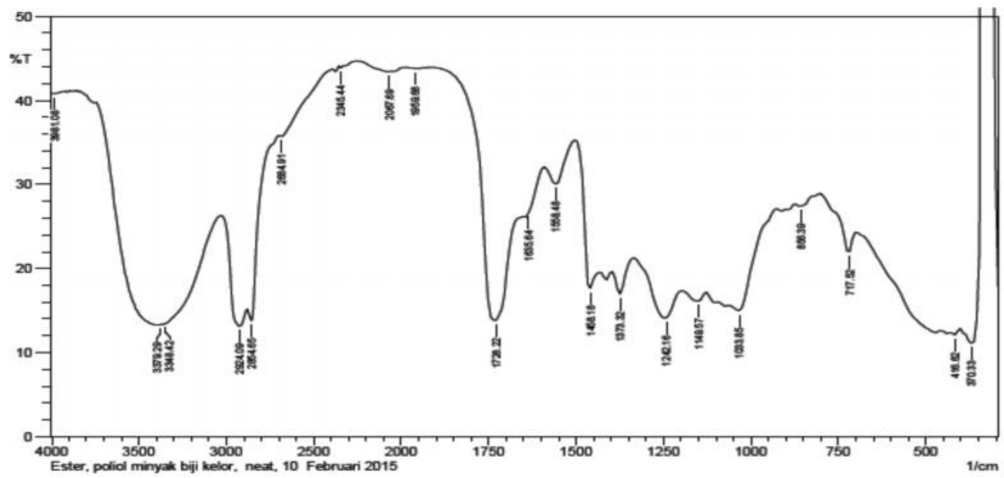


Figure.2 FT-IR spectrum from Synthesis of Polyol from *Moringa oleifera* seed o**i**l

FT-IR spectrum above showed that the polyol of *Moringa oleifera* seed oil had been formed which has the absorption spectrum at the wave number 717.52 cm^{-1} which was the characteristic absorption of vibrations rocking (CH2) ≥ 4, the wave number 856.39 cm^{-1} a typical absorption of oxirane -COC bending vibrations, the wavenumber 1149.57 cm^{-1} was a typical absorption of stretching vibration -CO, wavenumber 1242.16 cm^{-1} was a typical absorption of stretching vibration -COC- oxirane group, the wave number 1728 , 22 cm^{-1} was a typical absorption of -CO stretching vibration, the wave number 2854.65 and 2924.09 cm^{-1} was a typical absorption of saturated aliphatic -CH stretching vibration and the wavenumber 3379.29 cm^{-1} was an absorption typical of the -OH stretching vibration with high intensity and indicated that the polyol of *Moringa oleifera* seed oil was formed at high levels.

The other support test had been done by the determination of the iodine number, where from these results had been decrease in iodine number of 107.3769 mg I / gram of oil to 3.5755 mg I / gram of polyol.

No	Parameters	Polyol Compounds	Quality Standars
1	Spesific Gravity	0,978	>0,850
2	Kinematic viscosity 40 ^{o}C(cSt)	216,702	-
3	Kinematic viscosity 100 ^{o}C (cSt)	21,116	<24,0
4	Viscosity index	111,013	min.90

Table.1 Quality of Test from Polyol Compounds As Lubricant Base

4. Conclusion

The research had been done, which could be concluded that polyol compounds could be synthesized from *Moringa oleifera* seed oil which was evidenced by a decrease in iodine number of 107.3769 mg I / gram of oil to 3.6755 mg I / g polyol and characterization results by FT-IR spectroscopy showed OH groups at the wave numbers 3379.29 cm^{-1}.

Based on the test could be utilization as a lubricant base material and included in the classification of lubricating oil SAE gear manual transmission and axle class SAE 90, because it has kinematic viscosity 100 ^{0}C at 21.116 cSt, viscosity index value at 111.013 and specific gravitiy at 0.978.

5. References

Tjahjono, E.W. 2009. *Rancangan Teknologi Pengolahan Pelumas dari Asam Lemak (Fatty Acid*). M.P.I. 3(2): 140-148.

Prerna Singh, C., dan Chhibber, V.K. 2013. *Chemical Modification in Karanja Oil for Biolubricant Industrial Applications*. Journal of Drug Delivery & Therapeutics. 3(3): 117-122.

Sammaiah, A., Padmaja, K. V dan Prasad, R. B. N. 2014. *Synthesis of Epoxy Jatropha Oil and Its Evaluation for Lubricant Properties*. J. Oleo Sci. 63(6): 637-643.

Curtis, J., Liu, G., Omonov, T dan Kharraz, E. 2013. *Polyol Synthesis from Fatty Acids and Oils*. United States Patent Application Publication. Pub. No: US 0274494 A1.

Nasir, S., Soraya, D.F dan Pratiwi, D. 2010. *Pemanfaatan Ekstrak Biji Kelor (Moringa oleifera) untuk Pembuatan Bahan Bakar Nabati*. Jurnal Teknik Kimia. 17(3): 29-34.

Lalas, S dan Tsaknis, J. 2002. *Characterization of Moringa oleifera Seed Oil Variety "Periyakulum 1"*. Journal of Food Composition and Analysis. 15: 65-77.

Anwar, F dan Bhanger, M.I. 2003. *Analytical Characterization of Moringa oleifera Seed Oil Grown in Temperate Regions of Pakistan*. J. Agric. Food Chem. 51(22):6558-6563.

Activity Test Of Ethanol and n-Hexane Fraction Of African Leaves (*Vernonia amygdalina* Delile) as Antihyperuricemia On Male Mice Induced by Potassium Oksonat

Deni Karisnawati[1], Saibun Sitorus[2] dan Chairul Saleh[2]

[1] Laboratory of Organic Chemistry Faculty of Mathematics and Natural Science, Mulawarman University

[2] Chemistry Majors Faculty of Mathematics and Natural Science, Mulawarman University

Jalan Barong Tongkok No. 4 Kampus Gunung Kelua Samarinda, Kalimantan Timur

Corresponding Author: Deni09_2a1@ymail.com

ABSTRACT

Antihyperuricemia activity tests have conducted on a ethanol and n-hexane fraction African leaves *(Vernonia amygdalina Delile)*. Hyperuricemia is a condition in which uric acid levels in the blood increases due to the high consumption of purine converted to uric acid by xanthine oxidase. Antihyperuricemia activity test of ethanolic and n-hexane fraction of African leaves (*Vernonia amygdalina* Delile) conducted on male white mice with variation in doses of 6, 11 and 22 mg/kg BW and variation of measurement time of 1, 2, 3 and 4 hours after administration of the extract orally. Data were analyzed with ANOVA and continued with Duncan test. Ethanolic fraction 11 mg/kg is the most effective fraction lower uric acid levels by 54.62% compared to alupurinol 300 mg/kg BW which lower uric acid levels by 56.91%. Phytochemical screening showed that the ethanolic fraction of African leaves contains triterpenoids, steroids, phenolics, flavonoids and saponins whereas n-hexane fraction containing alkaloids, steroids and flavonoids. These results show the extracts of African leaves have antihiperurisemia activity.

Keyword: *Vernonia amygdalina Delile, Uric Acid, Antihyperuricemia, Phytochemical screening dan Enzyme Xanthine Oksidase*

Inroduction

About 300 species of plants have been traditionally used as a medicinal plant by traditional medicine industry[1]. Many traditional herb products have been processed with modern technology or simply circulating in the community. One of the plants that can be developed into drugs is African leaf (*Vernonia amygdalina* Delile).

African leaf (*Vernonia amygdalina* Delile), *Asteraceae* family, grows in the western part of the continent of Africa, especially in Nigeria[2]. The most prominent is the usefulness for treating diabetes, hypertension, reduces bad cholesterol, hardening of the liver, liver cancer, removal of toxins from the body (detoxification), antimalarial and gout.

Uric acid, final product of purine metabolism (nucleoprotein derivatives), is one component of nucleic acids that contained in the body of the cell nucleus. Normal levels of uric acid for man are from 3.4 to 7.0 mg/dL and 2.4 to 6.0 mg/dL for women. Normal levels of uric acid for mice is 0.5 to 1.4 mg/dL and mice will be got hyperuricemia when levels of uric acids reach 1.7 to 3.0 mg/dL[3].

Hyperuricemia is a condition that indicates levels of uric acid in the blood increases, and experiencing burnout. Hyperuricemia may caused by excessive production of uric acid or a reduced dumping caused by metabolic abnormalities due to genetic changes. Besides genetic factors, biochemical processes also play a role as a cause of hyperuricemia[4], while the inflammation in the joint area due to the deposition of uric acid known as gout.

In general, synthetic drugs used to treat hyperuricemia such as allopurinol, but it can cause side effects such as skin irritation, stomach, intestines and blood disorders. To overcome it, alternative treatment has been developed.

This research have conducted antihyperuricemia activity tests of ethanol and n-hexane fraction of African leaves (*Vernonia amygdalina* Delile) to decrease uric acid levels in the blood of hyperuricemia male mice induced by potassium oksonat. Examination of uric acid levels in the blood using strips uric acid test. According to[5], a chemical compound that could be expected to inhibit the action of the enzyme xanthine oxidase and superoksidase thereby reducing uric acid levels in the blood are flavonoid compounds. Results of the study[6], botanicals and ethanol extract of African leaves (*Vernonia amygdalina* Delile) contain flavonoids which are compounds capable of inhibiting the enzyme xanthine oxidase. This study aims to determine the efficacy of African leaves (*Vernonia amygdalina* Delile) as decreasing uric acid levels on male mice. In this case, the test animals are hyperuricemia male mice induced by potassium oksonat and the examination of uric acid levels in blood using strips uric acid test.

Theory/Methodology

Extraction of Secondary Metabolites Compounds

African leaves that have been dried and soft as much as 250 grams were macerated with 96% ethanol. Result of extract was concentrated using by a rotary evaporator to obtain a total ethanol extract. Total ethanol extract was fractionated with n-hexane to obtain two fractions, namely fraction of ethanol extract and fraction of n-hexane extract. In total ethanol extracts, fraction of ethanol extract and n-hexane extract have conducted phytochemical test to determine type of secondary metabolites of chemical compounds contained in each fraction. After that, fraction of ethanol extract and n-hexane extract have conducted antihyperuricemia activity test using uric acid meter to determine uric acid levels in the blood.

Phytochemicals Test

Alkaloid Test

Extract of African leaves was added a few drops of H_2SO_4 2 N and 3 drops of Dragendroff reagent (a mixture of $Bi(NO_3)_3.5H_2O$ in nitric acid solution and KI). The presence of alkaloids was indicated by orange to brown precipitate.

Triterpenoid and Steroids Test

Extract of African leaves was added a few drops of Lieberman-Buchard reagent (glacial acetic + concentrated sulfuric acid). Test positive of triterpenoids give red or purple and test positive of steroid test give green or blue.

Phenolic Test

Extract of African leaves was added 3 drops of solution $FeCl_3$ 1%, extract positive contains phenolic when produce green, red, purple, blue or black.

Flavonoids Test

Extract of African leaves was added Mg powder and a few drops of concentrated chloride acid. Positive test is indicated by the formation of red, yellow or orange.

Saponin Test

Extract of African leaves shaked in hot aquades, an aqueous solution of a saponin-containing sample produces foam, with a height of 1-3 cm which is stable for 15 minutes or more even with addition of 2-3 drops of concentrated chloride acid

Treatment in Animal Testing

This study was designed for 12 day treatment after a acclimatization period, blood uric acid levels of male mice were measured as the initial value on the day zero (0). Each group of mice was given a chicken liver juice 25 g/kg on day 1 to day 12. Furthermore blood uric acid levels was measured after fasting at day 13 consecutively at 0, 1, 2, 3, and 4 hours. Male mice was induced with potassium oksonat before first blood sampling.

Group 1:	(Control of hyperuricemia) was given a solution of Carboxyl Methyl Cellulose (CMC) 1% orally
Group 2:	(Control of comparator) was given juice chicken livers 25 g/kg orally, induction potassium oksonat 250 mg/kg and allopurinol suspension of 0,557 mg/kg
Group 3:	was given juice chicken livers 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 6 mg/kg ethanol fraction orally (dose I)
Group 4:	was given a chicken liver juice 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 11 mg/kg ethanol fraction orally (dose II)
Group 5:	was given a chicken liver juice 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 22 mg/kg ethanol fraction orally (dose III)
Group 6:	was given a chicken liver juice 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 6 mg/kg n-hexane fraction orally (dose I)

Group 7:	was given a chicken liver juice 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 11 mg/kg n-hexane fraction orally (dose II)
Group 8:	was given a chicken liver juice 25 g/kg orally, induction potassium oksonat 250 mg/kg and the suspension of 22 mg/kg n-hexane fraction orally (dose III)

Blood Sampling and Measurement of Blood Uric Acid Levels

Measurement of uric acid levels is done on the clock to 0, 1, 2, 3 and 4 hours. White male mice were put into an appropriate buffer. Mice were stretched out and lateral tail vein cut along 0.2-0.5 cm from the base of the tail with sterile surgical scissors. Mice blood smeared on uric-acid-strip and inserted into the tool uric acid meter and will be read as uric acid levels (mg/dL).

1.3 Data analysis technique

Data were analyzed using ANOVA test at 95% confidence level and continued with Duncan test to find out which group has a significant difference between the treatment groups.

1.4 Results and Discussion

1.5 Phytochemicals Test

Phytochemical screening is a preliminary stage in a phytochemical study that aims to provide an overview of the classes of compounds contained in the plant being studied. Phytochemical test is performed to determine the content of secondary metabolites in plant sample extract. Phytochemical test includes qualitative analysis of chemical constituents in plants or parts of plants such as roots, stems, leaves, flowers, fruits or seeds especially bioactive compounds. Phytochemical test carried out based on the reaction that produces a distinctive color or sediment for each class of secondary metabolites.

Results of phytochemical test has been conducted on African leaf extract (*Vernonia amygdalina* Delile) contained in the following table.

Table 1. Results of phytochemical test of African leaves (*Vernonia amygdalina* Delile) extract and fractions

Compounds	Extracts		
	Total extract	n-hexane fraction	Ethanol fraction
Alkaloids	+	+	-
Triterpenoids	+	-	+
Steroids	+	+	+
Phenolics	+	-	+
Flavonoids	+	+	+
Saponins	+	-	+

(+) = contains secondary metabolites

(-) = does not contain secondary metabolites

Flavonoids group has the potential to treat diseases caused by free radicals. Flavonoids are also effective inhibitors of several enzymes, including xanthine oxidase. Flavonoids potential as a cure for gout by lowering uric acid concentration and capture of superoxide activity in human tissue. Krisin compound, apigenin, luteolin, galangin, kaempfenol and quarsetin have xanthine oxidase inhibitory activity[7]. Other compounds such as polyphenols and saponins also has potential as an inhibitor of xanthine oxidase because it has a hydroxyl group as an electron acceptor from xanthine oxidase[8]. In the alkaloid compounds also have the ability sebaga xanthine oxidase inhibitor which inhibisnya unknown mechanism[9].

As cited in [10] the structure of flavonoids led to this class of compounds has potential as a competitive inhibitor of xanthine oxidase. Competitive inhibition occurs when a drug that acts as an inhibitor with a structure resembling normal enzyme substrate, compete with the normal substrate to be related to the enzyme active site[11].

Antihyperuricemia Activity Test

This study used eight test group, namely the control of hyperuricemia, control comparators and 3 test groups for each African leaf fractions. Antihyperuricemia test using consecutive doses of 6 mg/kg, 11 mg/kg and 22 mg/kg given orally in white male mice. On the first day of the trial, before being given chicken liver juice measured blood uric acid levels beginning of each group. Chicken liver juice be given at a dose of 25 g/kg two times as an approach to the human diet[12]. Giving chicken liver juice as enhancing the levels of uric acid due to the very high purine content of 243 mg/100g. Purine derived from food can increase the formation of uric acid due to increasing the activity of the enzyme xanthine oxidase.

The percentage increase in blood uric acid levels on ethanol fraction group contained in the following table.

Table 2. Percentage increase in blood uric acid levels of ethanol fraction group after potassium oksonat induction.

Group	Uric acid levels		Percentage increase
	After Fasting	After potassium oksonat induction	
Control of hyperuricemia	2,90	6,17	53,00%
Control of comparators	2,63	5,57	52,78%
Ethanol 6 mg/kg BW	2,83	5,53	48,82%
Ethanol 11 mg/kg BW	3.13	5,73	45,37%
Ethanol 22 mg/kg BW	2.97	6,20	52,10%

Increased levels of uric acid in the blood after administration of potassium oksonat oksonat is because potassium is an uricase inhibitor. Uricase is an enzyme found only in low-level mammals and was instrumental in the conversion of uric acid into allantoin that is easily soluble in water and is excreted. Potassium oksonat works by blocking the action of urikase so that the test animals experienced hyperuricemia conditions. Competitive inhibition of this enzyme urikase accumulation of uric acid in mice and may cause gout. Oksonat potassium dose that causes hyperuricemia is 250 mg/kg[13].

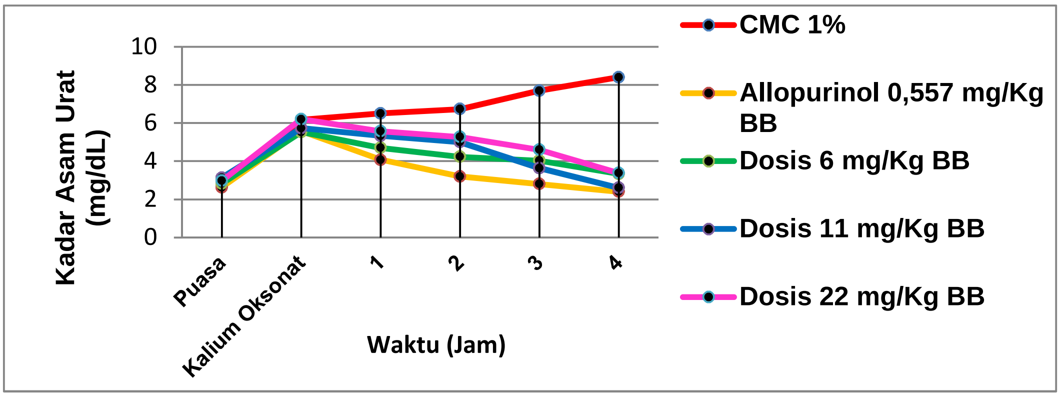
The percentage decrease in blood uric acid levels of ethanol fraction group contained in the following table.

Table 3. Percentage decrease in blood uric acid levels of ethanol fraction group

Group	Uric acid levels		Percentage decrease
	After Potassium oksonat induction	4 hours after extract induction	
Control of hyperuricemia	6,17	8,40	-
Control of comparators	5,57	2,40	56,91%
Ethanol 6 mg/kg BW	5,53	3,33	39,78%
Ethanol 11 mg/kg BW	5,73	2,60	54,62%
Ethanol 22 mg/kg BW	6,20	3,37	45,64%

Based on Table 3, the relationship between the effects of African leaves ethanol fraction with various doses on the blood uric acid levels after induction of potassium oksonat and the time variation measurements can be shown by Figure 1.

Figure 1. Chart of African leaves ethanol fraction effects against blood uric acid levels on white male mice with variations in measurement time



Based on Figure 1, uric acid levels of group 1 (was given CMC 1%) showed highest levels among the other treatment group. Group 1 is control of hyperuricemia, a control group that were not given the drug or the African leaf extract, so that the condition of white male mice according to the condition of hyperuricemia.

The percentage increase in blood uric acid levels of n-hexane fraction groups contained in the following table.

Tabel 4. Percentage increase in blood uric acid levels of n-hexane fraction group after potassium oksonat induction

Group	Uric acid levels		Percentage increase
	After Fasting	After potassium oksonat induction	
Control of hyperuricemia	2.9	6.17	53,00%
Control of comparators	2.63	5.57	52,78%
n-Hexane 6 mg/kg BW	2.87	5.87	51.10%
n-Hexane 11 mg/kg BW	2.2	4.3	48.84%

n-Hexane 22 mg/kg BW	2.57	5.1	49.61%

The percentage decrease in blood uric acid levels of n-hexane fraction group contained in the following table.

Table 5. Percentage decrease in blood uric acid levels of n-hexane fraction group

Group	**Uric acid levels**		**Percentage decrease**
	After Potassium oksonat induction	**4 hours after extract induction**	
Control of hyperuricemia	6.17	8.4	-
Control of comparators	5.57	2.4	56,91%
n-Hexane 6 mg/kg BW	5.87	4,0	31,85%
n-Hexane 11 mg/kg BW	4,3	2,60	39,53%
n-Hexane 22 mg/kg BW	5,2	2,53	50,39%

Based on Table 5, the relationship between the effects of African leaves n-hexane fraction with various doses on the blood uric acid levels after induction of potassium oksonat and the time variation measurements can be shown by Figure 2.

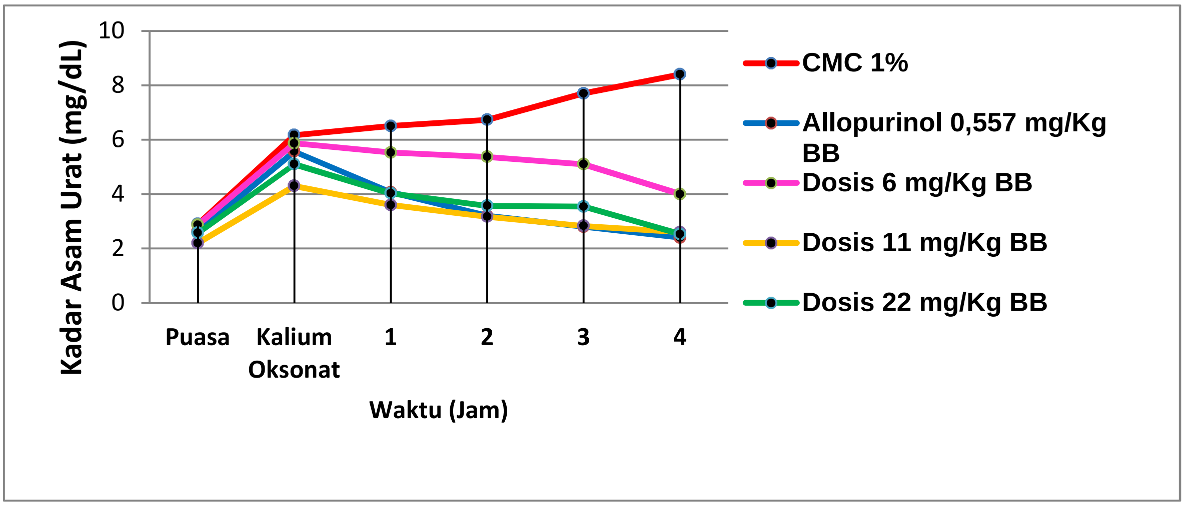


Figure 2. Chart of African leaves n-hexane fraction effects against blood uric acid levels on white male mice with variations in measurement time

Histogram of percentage decrease in blood uric acid levels of ethanol and n-hexane fraction group shown by Figure 3.

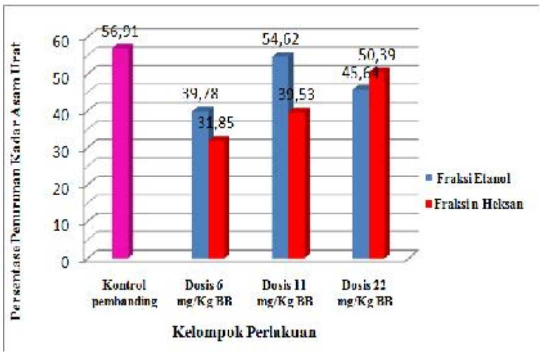


Figure 3. Histogram of ethanol and n-hexane fractions effects towards the percentage decrease in blood uric acid levels of white male mice groups

Based on Figure 3, maximum effect of the ethanol fraction work on vulnerable dose of 11 mg / kg with a percentage of 54.62% which is closer to the benchmark alloporinol that is equal to 56.91%. Antihiperurisemia effect of n-hexane fraction is smaller when compared with the effects of ethanol fraction. Maximum effect of n-hexane fraction worked at a dose of 22 mg / kg with a percentage of 50.39%. In the n-hexane fraction group, increasing doses influence the decreased levels of uric acid in the blood but its potential is smaller than the ethanol fraction. This is due to the active substance that is more effective in lowering the levels of uric acid is derived from polar groups, such as flavonoids.

An increase in the dose of medication should be improving the response is proportional to the dose increased, but with increasing dose response increase will eventually decline, as already achieved dose could no longer increase the response[14]. This often happens because of the components it contains not a single compound but rather consists of a wide variety of chemical compounds, in which these components work together to effect. But with increasing dose, the number of chemical compounds which contained more and more, so that the interaction causes a decrease in adverse effects. A limited number of receptors that also limits the effects, because not all of the drug can bind to the receptor, so even though the dose increased, the response did not increase.

Conclusions of data when analyzed with ANOVA is there are significant variations in concentration to decrease levels of uric acid in the blood of white male mice and no influence on the measurement time reduction in uric acid levels in the blood of white male mice.

Conclusion

African leaf (*Vernonia amygdalina* Delile) extract has efficacy as antihiperurisemia that can lower blood uric acid levels on male white mice induced by potassium oksonat. The results of the study showed that the ethanol fraction dose of 11 mg/kg BW have an antihyperuricemia effect approaching comparison controls that allopurinol dose of 300 mg/kg with the percentage decrease in blood uric acid levels by 54.62%, while allopurinol capable of lowering blood uric acid levels amounting to 56.91%. Ethanol fraction dose of 11 mg/kg showed no significantly different loss results with allopurinol dose of 300 mg/kg BW and percentage of deterioration in uric acid levels higher than the dose of the other variations.

Acknowledgement

The authors thank the Laboratory of Organic Chemistry and Laboratory of Biochemistry Faculty of Mathematics and Natural Science Mulawarman University for the facilities that have been granted and all those who have helped in the completion of the study.

References

Departemen Kesehatan RI. 2006. *Kotranas*. Jakarta : Departemen Kesehatan RI

Ibrahim, G., Abdurahman, E.M and Katayal, U.A. (2004). *Pharmacognostic Studies On The Leaves Of Vernonia amygdalina Del. (Asteraceae)/ Nig. J. Nat. Orid And Med*. 08(1) : 8-10

Febrina, M., Arifin, H., dan Almahdy. 2011. *Pengaruh Pemberian Allopurinol dan Probenesid Terhadap Kadar Asam Urat Mencit Diabetes.* Padang : Universitas Andalas Padang.

Dalimartha, S. 2002. *Resep Tumbuhan Obat Untuk Asam Urat.* Jakarta : Penebar Swadaya

Wahyuningsih, H. K. 2010. *Pengaruh Pemberian Ekstrak Herba Meniran (Phyllantus niruri L.) Terhadap Penurunan Kadar Asam Urat Darah Tikus Putih Jantan Hiperurisemia.* Skripsi Penelitian. Surakarta : Fakultas Kedokteran Universitas Sebelas Maret

Gunanta, I. S. 2013. *Efek Inotropik dan Kronotoropik Ekstrak Etanol Daun Afrika (Vernonia amygdalina Delile) Pada Isolat Jantung Tikus.* Skripsi Penelitian. Medan : Universitas Sumatra Utara

Yulianto, D. 2009. *Inhibisi Xantin Oksidase Secara In Vitro Oleh Ekstrak Rosela (Hibiscus sabdariffa) dan Ciplukan (Physalis angulata).* Departemen Kimia FMIPA : Institut Pertanian Bogor

Wulandari, S., Subandi dan Muntholib. 2013. *Inhibisi Xantin Oksidase Oleh Ekstrak Etanol Kulit Melinjo (Gnetum gnemon) Relatif Terhadap Allopurinol*. Jurnal Penelitian. Malang : Universitas Negeri Malang

Azmi, S. M. N., Jamal, P. dan Amid, A. 2012. *Xanthine Oxidase Inhibitory Activity From Potential Malaysian Medicinal Plans as Remedie For Got*. International Food Research Journal 19 (1) : 159-165

Lin, C. M., Chen, C. S., Chen, C. T., Liang, Y. C. dan Lim, J. K. 2002. *Moleculer Modeling of Flavonoid That Inhibits Xanthine Oxidase.* Biechemical and Biophysical Research Communications. 294 : 167-172

Ophardt, C. 2003. *http : //chemwiki. ucdavis. edu/Biological_Chemistry /Drug_ Activity/Enzyme_Inhibition.html.* Diakses 10 April 2015

Darminto, B. 2010. *Khasiat Anthiperurisemia Ekstrak Kulit Batang Mahoni .(Swietenia macrophylla* King*) pada Tikus Putih Galur Sprague Dawley.* Skripsi Penelitian. Bogor : FMIPA Institut Pertanian Bogor

Astuti, L. W., Widdhi B., Agnes F. S,. 2014. *Efek Ekstrak Etanol Daun Salam (Syzygium polyanthum (Wight.) Terhadap Penurunan Kadar Asam Urat Tikus Putih Jantan Galur Wistar (Rattus novergicus L.) Yang Diinduksi Potasium Oksonat.* Jurnal Ilmiah Farmasi Vol. 3 No 2. Mei 2014 ISSN 2302-249

Mariani I. T., Saiful, B. Dan Awaluddin, S. 2012. *Aktivitas Antihiperurisemia Ekstrak Etanol Herba Suruhan (Peperomia pellucida (L.) Kunth) Pada Mencit Jantan.* Medan : Fakultas Farmasi Universitas Sumatra Utara.

ANTIHYPERGLYCEMIC TEST OF ETHANOL EXSTRACT OF DURIAN (*Durio zibethinus* Murr.) PEEL AGAINTS MALE MICE (*Mus Musculus*)

Hamsiana[1], Rudi Kartika[*], Chairul Saleh

[1]Laboratarium Biokimia and Organik Jurusan Kimia FMIPA Universitas Mulawarman

ABSTRACT

Diabetes mellitus (DM) is a metabolic disorder and characterized by hyperglycemic circumstances. Hyperglycemic is a condition where the glucose levels ini the blood increased dramatically. One of the pharmacological therapy ia to use ofdrugs that can reduse glucose levels in the blood. Phytochemical test and antihyperglicemic activity from durian (Durio zibethunus Murr.) peel have been carried out. Durio zibethinus Murr. peel was macerated with ethanol 96% then concentrated with rotary evaporators. It obtained rendemen 13.33% . Based on the test result of phytochemistry of secondary metabolites compounds from durian peel showed that etahanol extract containing flavonoid, alkaloid, fenolik, triterpenoid and saponin. Antihyperglicemic activity test use animal test male mice that is injected aloksan. Measurement of blood sugar levels using glucometer and glucose test strip. From antihyperglicemic test it showed that the effectiveness of blood sugar level doses of 36 mg/kg BW from the results of measurments showed high levels of glucose in the blood of 82.33 mg/dL.

Keywords: Durian (Durio zibethinus Murr.) peel, antihyperglicemic test, phytochemistry test.

Introduction

Indonesia was awarded the natural wealth of spacious forest resources with all the potential contained therein. One type of non-timber forest products that could be potentially high economic benefit is plant [1]. Indonesian medicinal plants can be categorized into three namely herb which is a traditional herb that has not been clinically tested, herbal medicine is natural medicines that have passed the stage of preclinical testing, while fitofarmaka is natural medicines that have passed through preclinical testing and clinical (SK Head of BPOM No. HK.00.05.4.2411 dated May 17, 2004). Natural medicines can be used to treat various illnesses such as degenerative diseases like coronary heart disease, hypertension, hyperlipidemia and diabetes mellitus [2]. One of the plants that can be used as a medicinal plant is durian peel.

Durian peel is used as an upset stomach, constipation drugs, ulcer drugs, as organic fertilizers and insect repellent [3]. From the research that has been done by Hanny Setyowati, Hananun Zharfa Hanifah and Rr Putri Nugraheni that durian peel contains active substances from the class of flavonoids, saponins, tannins and phenolics. Based on information from poeple in Muara Badak area, durian peel is used for decreasing glucose levels in blood on people with diabetes mellitus. Condition of diabetes mellitus can be exacerbated by hyperglycemic [4].

This research aims to determine the antihyperglycemic effect of durian peel by using male mice weighing ± 20-30 grams as testing media and giving alloxan to create a hyperglycemic condition. The reason of this research is to determine whether ethanol extract of durian peel can decrease glucose levels in blood. In this research, measurement of glucose levels in blood using a glucometer and glucose test strips.

Methods

Extraction

Sample that have been dried and pulverized was extracted by using maceration method. It is by immersing the samples with ethanol 96% in room temperature. Filtrate obtained is then filtered using a glass funnel to separate the extract of plant material. Result of extraction was concentrated by rotary evaporator to obtain a thick extract. Then filtrate was put back into vessel maceration for further processing.

Phytochemicals Test

1. Alkaloids Test

   Ethanol extract of durian peel was dropped on the filter paper or TLC plate. Furthermore, it was sprayed by Dragendroff reagent (a mixture of $Bi(NO_3)_2.5H_2O$ in nitric acid solution and KI). The presence of alkaloids was indicated by brown orange patches on yellow background.

2. Flavonoids Test

   Ethanol extract of durian peel was added 2 mg of Mg powder and 3 drops of concentrated HCl. Positive test was indicated by red-yellow or orange color.

3. Triterpenoid/Steroids Test

   Extract ethanol of durian peel was added 3 drops of reagent Lieberman-Burchard (glacial acetic acid + concentrated H2SO4). Positive test of terpenoids give red or purple and positive tes of steroids test give green or blue.

4. Phenolic Test

   Ethanol extract of durian peel was added a few drops solution of iron (III) chloride ($FeCl_3$) 10%, extract positive contains phenolic when produce green, red, purple, blue or black.

5. Saponin Test

   Ethanol extract of durian peel was added hot water, strong shaking, if there is foam and then added 1 drop of concentrated HCl. Positive test of saponins was indicated by arising foam with a height of 1-3 cm which lasted for 15 minutes.

Antihyperglycemic Test

The dose used in this research was calculated based on dose that use on people (weight 50 kg) as much as 10 grams of dry peel. At the dose conversion table, the human body weight of 70 kg and a conversion table of human to mice are 0.0026. So based on the calculation, the dose was 18 mg/kg of body weight.

In antihyperglycemic test used five test groups, namely:

1. Group 1 (Negative): Given a standard feed and water, CMC Na 1%
2. Group 2 (Positive): Injected Alloxan 100mg/Kg of body weight, glibenclamide dose 0.009 mg/20 grams of body weight, standard feed and water
3. Group 3 (low dose): Injected alloxan 100mg/Kg of body weight, ethanol extract of durian peel with dose 9 mg/Kg of body weight, standard feed and water
4. Group 4 (medium dose): Injected alloxan 100mg/Kg of body weight, ethanol extract of durian peel with dose 18 mg/Kg of body weight, standard feed and water
5. Group 5 (high dose): Injected alloxan 100mg/Kg of body weight, ethanol extract of durian peel with dose 36 mg/Kg of body weight, standard feed and water

Sample Analysis

Before measurements, mice were fasted for 18 hours. Blood sampling the mice were taken from mice tail. Glucose levels in mice blood were analyzed by using a glucometer and glucotest strips with glucose measurement principle is based on the following reaction:

$$\text{B-D-Glukosa} + O_2 + H_2O \xrightarrow{\text{glukosa oksidase}} H_2O_2 + \text{asam glukonat}$$

$$H_2O_2 + \text{krmogen} \xrightarrow{\text{peroksidase}} \text{iodida} + H_2O$$

Results and Discussion

Extraction

In this research, the solvent used is ethanol 96%, since almost all active compounds present in crude drugs can be extracted by using ethanol. The extraction process is done by maceration. The amount of yield from the maceration can be seen in the following table.

Table 1. Percent yield of extracted durian peel.

Sample	Initial Weight (gr)	Extract Weight (gr)	Yield (%)
Kulit Durian	240	32	13.33

Phytochemicals Test

Results of phytochemical test was done to ethanol extract of durian peel can be seen in the following table.

Table 2. Results of phytochemical test.

Compounds	Contents
Alkaloid	+
Flavonoid	+
Steroid	-
Triterpenoid	+
Fenolik	+
Saponin	+

Description:

(+) = contains secondary metabolites

(-) = does not contain secondary metabolites

Antihyperglycemic Test

Diabetes mellitus is a disease of insulin hormone disorder in which the amount of insulin produced by the pancreas just a little or the lack of ability of insuline as the receptor that causes glucose to accumulate in the blood and excreted by the body through the urine so people sometimes call diabetes. Diabetes mellitus is accompanied by hyperglycemic. Hyperglycemic is a condition of glucose levels in blood increase.

Table 3. Results of the measurement of glucose levels in the blood (mg/dL).

Treatment Group	Kadar Glukosa dalam Darah (mg/dL)		
	0 day	**8th day**	**18th day**
Group 1	59.67	69.33	72.33
Group 2	58.33	189.67	56.67
Group 3	57.67	210.67	85.33

Group 4	58.33	213.67	84.67
Group 5	57.33	228.33	80.67

Tabel 4. The percentage increasing of glucose levels after administration of alloxan.

Treatment Group	Fasting Glucose Levels mg/dL (0 day)	Increasing of Glucose Levels mg/dL (8th day)	Percent Increasing of Glucose Levels (%)
Group 1	59.67	69.33	1.68
Group 2	58.33	228.33	74.45
Group 3	57.67	210.67	72.63
Group 4	58.33	213.67	72.70
Group 5	57.33	228.33	74.89

The principle of alloxan test is diabetes induced in animal test that given alloxan injection intravenously in tail with a dose of 100 mg/kg of body weight. And different animal test with different conditions will produce different doses. Giving oral antidiabetic drug can reduce glucose levels in blood [5].

Table 5. Percentage reduction of glucose levels following administration of the treatment (glibenclamide and durian peel extract)

Treatment Group	Increasing of Glucose Levels mg/dL (8th day)	Decreasing of Glucose Levels mg/dL (18th day)	Percent Decreasing of Glucose Levels (%)
Group 1	69.33	72.33	-0.043 (Incraese)
Group 2	189.67	56.67	70.37
Group 3	210.67	85.33	59.4
Group 4	213.67	84.67	60.37
Group 5	228.33	82.33	63.94

In research of ethanol extracts durian peel decrease blood glucose levels of mice. The decrease glucose levels in the blood of mice by the extracts ethanol the peel durian can be explained trough two main mechanisms, which is in intra pancreatic and extra pancreatic. The mechanism intra pancreatic to work with improving (regeneration) β cells of pancreatic and protects β cells from damage as well as stimulating the release of insulin by the active compounds alkaloids and flavonoids. Alkaloids have the ability to regenerate in which had to be real has the ability to regenerate β cells the pancreas. The increase in the secretion of insulin is caused by the effects of nerve stimulation of the sympathetic alkaloid effect to increase in the secretion of insulin. Flavonoid has properties as a antioxidants, that can protect the damage of the pancreas cells from free radicals [6] with capturing or neutralizing free radicals with the OH groups so as to repair the of damaged tissue [7]. The phenolic also has antioxidant activity which can reduce oxidative stress in a way to prevent the occurance of a chain reaction of changing as a hydrogen as a way to danate the hydrogen atoms of aromatic hydroxide to tie up free radicals and throw it away from the body through the system of excretion. [8, 9, 10].

Extra pancreatic mechanisms can take place through a variety of mechanisms. Alkaloids lowers blood glucose by inhibiting the absorption of glucose in the gut by inhibiting GLUT 2 at the intestinal mucosa, and blood glucose levels decrease, increases the transport of glucose in the blood, stimulates glycogen synthesis and inhibits synthesis of glucose by inhibiting the enzyme glucose 6-phosphatase, fructose 1, 6-bifosfatase, as well as increasing the oxidation of glucose by glucose 6-phosphate dehydrogenase. Glucose 6-phosphatase and fructose 1,6-bifosfatase is an enzyme that plays a role in gluconeogenesis. Fructose-1,6-bisfosfatase converts fructose-1,6-bisphosphate to fructose-6-phosphate, so the reverse reaction catalyzed by phosphofructokinase. Glucose-6-phosphatase are found at the beginning of glycogen metabolism, catalyzes the final reaction of gluconeogenesis and convert glucose-6-phosphate into glucose bebas.Penghambatan on both these enzymes would reduce the formation of glucose from other substrates in addition to carbohydrates [6].

Conclusion Research

From the research has been done, can be concluded ethanol extracts peel durian (*Durio zibethinus* Murr.) contain alkaloids, flavonoids, saponins, triterpenoids and phenolic. Peel durian has antihyperglycemic activity that can lower blood glucose levels in hyperglycemic male mice, in which the dose effective use is 36 mg/kg WB of the measurement results show blood glucose levels of 82.33 mg/dL.

Acknowledgement

The author expressed her gratitude to the head of the laboratory of biochemical and organic to do research in labs.

Referention

Kinho, J., Ariani, D.I., Halawane, J., Nurani, L., Halidah., Kkafiar, Y and Karundeng, M, “Tumbuhan Obat Tradisional Disulawesi Utara”, Manado, Balai Penelitian Kehutanan Manado, 2010

Suyono, S, “Diet Dalam Diabetes”, in: Buku Ajar Ilmu Penyakit Dalam Jilid 1 Edisi Ketiga, Jakarta, Balai Penerbit Fakultas Kedokteran Universitas Indonesia, 2003

Putri, A.N.N, 2013, “Kompasiana”, update 7.12.2014, URl http://kesehatan.kompasiana.com/alternatif/2013/11/02/dibalik-duri-yang-tajam-kulit-ini-memiliki-berbagai-khasiat-604619.html

Moore, M.C, “Terapi Diet and Nutrisi”. , Jakarta, Hipokratos, 1997

DepKes RI, “Pharmaceutical care untuk penyakit diabetes mellitus”, . Kementerian Kesehatan RI, 2005

Arjadi, F andSusatyo, P, “Regenerasi Sel Pulau Langerhans Pada Tikus Putih (Rattus norvegicus) Diabetes yang Diberi Rebusan Daging Mahkota Dewa (Phaleria macrocarp (scheff.)Boerl.)”, Vol. 2, No.2, (2010)

Botutihe, Dalam Okky, M.P., Simon, B.D., “Uji Efek Ekstrak Air Daun PanandWangi Terhadap Penurunan Kadar Glukosa Darah and Histologi Tikus Diabetes Mellitus”, Jurnal Pangan dan Agroindustri Vol.2 No.2 p.16-27, April 2014

Barbosa, D.S, “Green Tea Polyphenolic Compounds and Human Health”, Journal of Consumer Protection and Food Safety. 2: 407-413 (2007)

Evans, J.L., Goldfine, I.D., Maddux, B.A., and Grodsky, G.M, “Are Oxidative Stress-Activated Signaling Pathways Mediators of Insulin Resistance and β Cells Dysfunction”, Diabetes Journal. 52 (1): 1-18 (2003)

Sabu, M.C., Smitha, K andRamadasan, K., “Anti-diabetic Activity of Green Tea Polyphenols and Their Role In Reducing Oxidative Stress In Experimental Diabetes”, Journal Ethnopharmacol. 83: 109-116 (2002)

PROFILE OF STUDENT'S MISCONCEPTIONS TOWARDS LEARNING SCIENCE

Wike Kusuma Wardani and Ummu Kulsum
Universitas Negeri Surabaya
Email: wike_kr_06_37@yahoo.co.id

ABSTRACT

Students' understanding of science can lead to misconceptions. This study aimed to describe profile of student's misconceptions towards learning science. Based on data ofstudents misconceptions on learning science, will be formulated students learning process. The participants of this research were students of class VII A in Public Junior High School 5 Surabaya. Student's misconceptions were determinedbased on the results of understanding on learning science tests that was designed in the form of CRI (Centainty of Response Index). Verification of high intensity misconceptions was done by identifying misconceptions in groups. Data for identification of misconceptions in the group was based on the average value of CRI of respondents who answered correctly (CRIB), respondents who answered incorrectly (CRIS), and the fraction of respondents who answered correctly (Fb). The results of this study were (1) 16 items from 26 (61.5%) was misconceptions, and (2) misconceptions students with high intensity occurred in the concept of the use of reasoning, experimentation, the nature of scientific ideas, scientific ideas democratically, the task of scientists, nature scientists, science is a boring science, the ability of students to learn science, and the students' understanding of the philosophy of science.

Keywords: misconceptions, science learning, CRI

Preface

Novak&Gowin (1984) stated that misconception is an interpretation of the concepts in a statement that can not be accepted. Brown (Suparno, 2005) stated that misconception is a wrong explanation and an idea that is not accordance with scientific understanding by the experts. Misconceptions can be interpreted as inaccuracies about a concept, using of the wrong concept, classification of any examples of the application of the concept, different meaning of concepts, confusion of different concepts, and the relationships of concepts that is not true.

It is not easy to improve student's misconceptions but teachers should always improve their mastery of concepts in order to recognize the difficulty that was occured. Each student has misconceptions in the school with various causes. According to the philosophy of constructivism, the students' knowledge is constructed or built by theirself. The process of construction is obtained through interaction with objects, events and environments. By the time students interact with the learning environment, students construct their knowledge based on experience. When this process occurs, a great risk of error is naturally happenedbecause students are not accustomed to construct their own knowledge appropriately. Especially if it is not provide clear and accurate source of information, the misconceptions are occured.

There are many ways to help students overcome their misconceptions. In general, the right tips to help students are looking for students fault and causes and also find the ways to overcome these misconceptions. Students' understanding of learning science is a factor to known science concept. Whilestudents perceptions towards science learning affects on students' motivation and students' motivation which is low affect on students' misconceptions. In addition, without understanding the value, the assumptions and the process of scientific knowledge, students will haqave difficultieswhen construct their understanding of science which is consists of facts, knowledge that is relevant and can be applied (Lederman, 2002).Based on the statement above can be concluded that students' perceptions of science learning can result in misconceptions. Hence identification of misconceptions students towards learning science is needed.

METHODS

The participants of this research were students of class VII A public junior high school 5 Surabaya. Students' misconceptions were determined by test results of the students' understanding of the concept of teaching science along with certainty of response index or CRI. Students with correct answers andtheir CRI level is low (0 to 2.5) expressed do not know the concept. Students with correct answers with CRI level is high (2.5 to 5) expressed idea of the concept. While students with the wrong answer with CRI level is high expressed misconceptions. Verification of high intensity misconceptions can be done by identifying misconceptions in groups. Data for identification of misconceptions in the group was based on the average value of CRI of respondents who answered correctly (CRIB), respondents who answered incorrectly (CRIS) and fraction of respondents who answered correctly (Fb).

RESULTS AND DISCUSSION

RESULTS

The test results of students towards learning science presented in Figure 1.

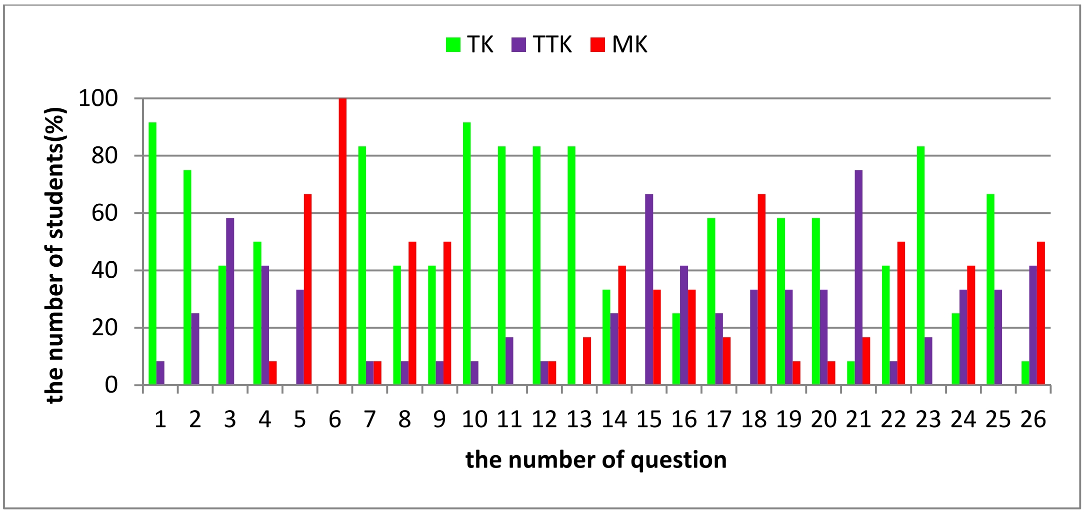


Figure 1 Percentage of Students Knew Concepts (TK), Do not Know Concept (TTK) andMisconceptions (MK) Learning of ScienceConcepts in Class7A

Based on the data in the Figure 1 was given the results of the analysis as follows: (1) Understanding of the students to the concept of science and learning are very diverse. Some of them did not happen at all, namely the misconceptions about the numbers 1, 2, 3, 10, 11, 23, and 25. Several problems are misconceptions and did not know the conceptsare number 5, 6, 15, and 18. Other questions understood vary in terms of the combination of the idea of the concept, did not know the concepts and misconceptions with different percentages, (2), there are two questions that many understood by students know the concept is a matter of numbers 23 and 25 in the barriers of learning science concept. Three question are misconceptions by more than 40% of the total number of students. There arequestion number 22, which asked that the science is the science is boring, question number24 asks about the ability of the students to learn science, and question number26 asks about students' understanding of the philosophy of science, and (3) comparison of the average TK: TTK: MK is at 4.5: 2.4: 2.7. This is showed that the students understanding are more likely to know concept than not know the concepts and misconceptions.

Some questions were successfully confirmedas high intensity misconceptionsare the numbers 5, 6, 9, 14, 15, 18, 22, 24 and 26 were asked about the use of reasoning, experiment, the nature of scientific ideas, scientific ideas democratically, the task of scientists, natureof scientists, science is boring, the ability of students to learn science, and the students' understanding of the philosophy of science. Verification of the results can be done by identifying misconceptions in groups. Data for identification of misconceptions in the group based on the average value of CRI of respondents who answered correctly (CRIB), respondents who answered incorrectly (CRIS) and the fraction of respondents who answered correctly (Fb) is presented in Figure 2.

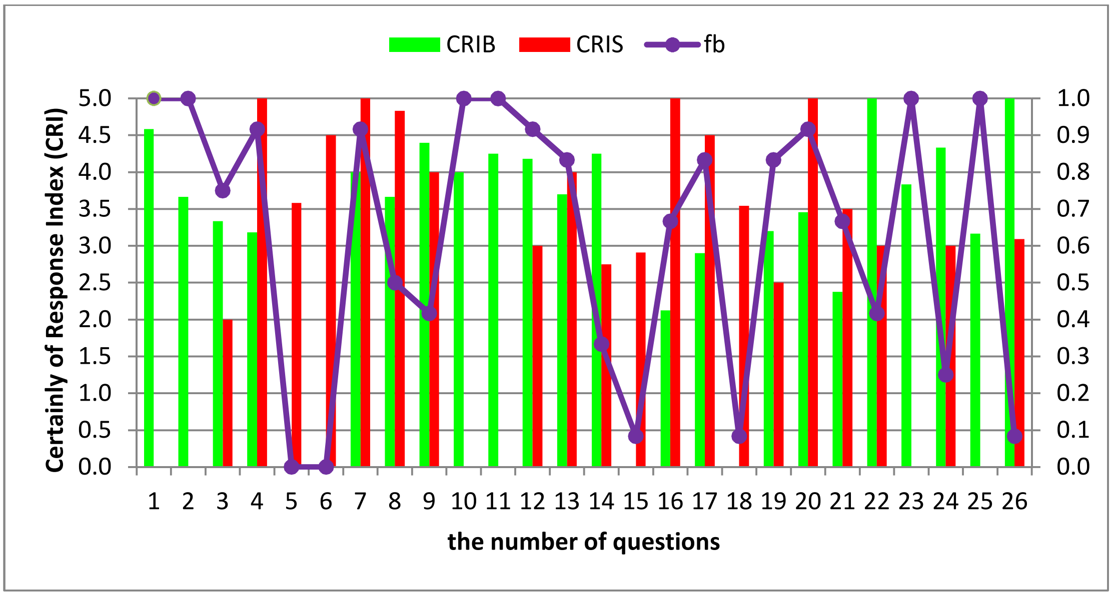


Figure 2 Comparison of CRIB, CRIS, and Fb Each Item Test Concept of Learning scienceinClass7A

Based on the data in Figure 2 shows that: (1) It turns out that most of the matter showed CRIS ≥ 2.5, it indicates the item was conceived misconceptions, (2) Not all items showed misconceptions criteria (students known the concept), some them are number 1, 2, 3, 10, 11, 23, and 25. Problem number 1 and 2 ask about understanding science, question 3 asks about the use of the scientific method, question 10 asks about the observations of scientists , question 11 asks about the evidence of scientific ideas, question number 23 and 25 asked about barriers to learning science, (3) Problems with high intensity misconceptions are numbers 5, 6, 9, 14, 15, 18, 22, 24, and 26, and (4) Problem with very little right fraction is about the number 5 and 6 (none of students who answer correctly), then the question number 9, 14, 15, 18, 22, 24 and 26.

DISCUSSION

The students' conceptions of science and learning include several aspects involving(1) how students understand science?, (2) Is it science?, (3) Is this a science or not?, (3) What is the application of science in life?, and (4) what can science do?.Based on the four aspects, this reasearch observed the concept of the definition of science, the scientific method, observation of scientists, science and scientific ideas and barriers to learning science.The results of study showed that 0%misconceptions at the fiveconcepts. Their experience in learning are sufficient and some science books already clearly explained the understanding of science, the use of some of the scientific method, observation in learning activities and concluding observations provide insight to students how the observations were made and the purpose for and the importance of science in everyday life.

Some problems were misconceptions with high intensity is a of numbers 5, 6, 9, 14, 15, 18, 22, 24 and 26 were asked about the use of reasoning, experimentation, the nature of scientific ideas, scientific ideas democratically, the task of scientists, nature scientists, science is boring, the ability of students to learn science, and the students' understanding of the philosophy of science. Researchers suspect a student's understanding of the concept of science and learning is a result of a learning experience in school and outside of school as proposed by Solomon, Scott &Duveen (1996) and Songer and Linn (1991). Learning science at school, however, can not reflect all of the scientist activity (Millar, 1998). Learning science does not reflect all the activity, itproven by questions which conceived students'misconceptions with high intensity.

High intensity students misconceptions showednine responses including: (1)students understand when the scientists analyzed the problem they use either was inductive and deductive reasoning. Their should understand that using a reasoning should not be deductive and inductive, scientists use a variety of models of reasoning. Since the 17th century, inductivism and several other epistemological stances that aimed to achieve the same end (although in those latter stances the criterion of certainty was either replaced with notions of high probability or abandoned altogether) have been debunked, such as Bayesianism, falsificationism, and hypothetico-deductivism (Gillies, 1993). Nonetheless, some of those, especially inductivism and falsificationism, are still widely popularized in science textbooks and even explicitly taught in classrooms. The myth of the scientific method is regularly manifested in the belief that there is a recipelike stepwise procedure that all scientists follow when they do science. This notion was explicitly debunked: There is no single scientific method that would guarantee the development of infallible knowledge (AAAS, 1993; Bauer, 1994; Feyerabend, 1993; NRC, 1996; Shapin, 1996). It is true that scientists observe, compare, measure, test, speculate, hypothesize, create ideas and conceptual tools, and construct theories and explanations. However, there is no single sequence of activities (prescribed or otherwise) that will unerringly lead them to functional or valid solutions or answers, let alone certain or true knowledge.(2) The experiment is an important part of the scientific process.In fact, there are *many*ways to test almost any scientific idea; experimentation is only one approach. Some ideas are best tested by setting up a controlled experiment in a lab, some by making detailed observations of the natural world, and some with a combination of strategies. To study detailed examples of how scientific ideas can be tested fairly, with and without experiments. (3) Scientific ideas is temporary and may change, so that itcan not be trusted. The idea can be changed, but scientific ideas have not changed, the new discovery will strengthen the scientific ideas before. Scientific knowledgeis never absolute or certain. This knowledge, including facts, theories, and laws, is subject to change. Scientific claims change as new evidence, made possible through advances in thinking and technology, is brought to bear on these claims, and as extant evidence is reinterpreted in the light of new theoretical advances,changes in the cultural and social spheres, or shifts in the directions of established research programs. Tentativeness in science does not arise solely from the fact that scientific knowledge is inferential, creative, and socially and culturally embedded. There are compelling logical arguments that lend credence to the notion of tentativeness. Indeed, contrary to common belief, scientific hypotheses, theories, and laws can never be absolutely proven irrespective of the amount of supporting empirical evidence (Popper, 1963).(4) Scientific ideas are considered democratic, based on the popularity of the idea.(5) The task of a scientist is seeking support for their hypothesis.Scientific ideas are judged not by their popularity, but on the basis of the evidence supporting or contradicting them. A hypothesis or theory comes to be accepted by many scientists (usually over the course of several years or decades) once it has garnered many lines of supporting evidence and has stood up to the scrutiny of the scientific community. A hypothesis accepted by "most scientists," may not be "liked" or have positive repercussions, but it is one that science has judged likely to be accurate based on the evidence(6) The scientists truly objective when evaluating themselves of scientific ideas and evidence. Scientists are not entirely objective, beliefs and goals with one another differently.Scientists do strive to be unbiased as they consider different scientific ideas, but scientists are people too. They have different personal beliefs and goals — and may favor different hypotheses for different reasons. Individual scientists may not be completely objective, but science can overcome this hurdle through the action of the scientific community, which scrutinizes scientific work and helps balance biases. (7) Science is boring. Memorizing facts from a textbook can be boring — but science is much more than the knowledge that makes its way into school books. Science is an ongoing and unfinished process of discovery. Some scientists travel all over the world for their research. Others set up experiments that no one has ever tried before. And all scientists are engaged in a thrilling quest to learn something brand new about the natural world. Some parts of scientific training or investigations may be tedious, but science itself is exciting. (8) I'm not good at science.Students who claimed not good at science, perhaps because finding difficulty in studying science. They still have not found an interesting part of the science and the ways that is easy to understand science.And (9) teaching about the nature and process of science is not allowed, because this topic is not included in the standard competence.It has been made clear in the instructions education standards of science and documents of reform that the nature and process of science is an important part for children and science education among young children or even adults.

Students who understand the concept of science and learning is the students who understand the activity of science, scientists and how they work, where a wide range of scientific method, the interrelationship between science and technology between various disciplines in science (Carl, 2006). Without understanding the value, the assumptions and the process of scientific knowledge, the students will have difficulty in constructing a science which is consists of facts, knowledge that is relevant and can be applied (Lederman, 2002). Another opinion expressed by Mullis and Jenkins (inMeichtry,1993) stated that the understanding of the concept of science and learning that can either provide the intellectual capability which is needed by a person to develop science and technology.In addition, NOS literacy is important in helping students ofscience confront the “new age of intellectual barbarism” that seems to be encroaching upon modern society. It helps them to make informed decisions relating to science-based issues, develop in-depth understandings of science subject matter, and help them to distinguish science from other ways of knowing. (NSTA, 2003) NOS literacy helps student defend themselves against unquestioning acceptance of pseudoscience and reported research (Park, 2000; Sagan, 1996).

Wrong understanding is created through the experience of learning. It regarding the use of reasoning, for example, students may have learned different types or methods of reasoning and have been applying it as the inquiry model of learning that apply but the students do not understand what the reasoning is.

CLOSING
CONCLUSION

Junior high school students experienced misconceptions on the concept of science and learning about the use of reasoning, experimentation, the nature of scientific ideas, scientific ideas democratically, the task of scientists, nature scientists, science is science is boring, the ability of students to learn science, and the students' understanding of the philosophy of science.

RECOMMENDATION

The facts show that still finding students who have misconceptions about learning of science concept should be addressed to decreasetheir misconceptions. For the further research, conceptual change could be implemented to reduce the misconceptions detected through the misconception test in learning science with CRI.

REFERENCES

American Association for the Advancement of Science. (1993). Benchmarks for scienceliteracy: A Project 2061 report. New York: Oxford University Press.

Bauer, H.H. (1994). Scientific literacy and the myth of the scientific method. Champaign,IL: University of Illinois Press.

Carl J. Wenning, CoordinatorA framework for teaching the nature of science *J. Phys. Tchr. Educ. Online*, *3*(3), March 2006

Feyerabend, P. (1993). Against method. New York: Verso.

Gall, M.D., Borg,W.R., & Gall, J.P. (1996). Educational research: An introduction (6th ed.).New York: Longman.

Gillies, D. (1993). Philosophy of science in the twentieth century: Four central themes.Cambridge: Blackwell..

Lederman, Norm G. Et al.. 2011. Views of Nature of Science Questionnaire: Toward Valid and Meaningful Assessment of Learners' Conceptions of Nature of Science. *Journal of Research in Science Teaching.*

Lederman, N.G., Abd-El-Khalick, F., Bell, R.L. & Schwartz, R.S.(2002). Views of the nature of science questionnaire: Towardvalid and meaningful assessment of learner's conceptions ofthe nature of science. *Journal of Research in Science Teaching,39*(6), 497-521.

Meichtry, Yvonne.J. 1993. The Impact of Science Curricula on Student Views About the Nature of Science. *Journal of Research in Science Teaching*, 30 (5): 429-443.

Millar, R., &Osborne, J. (Eds.) (1998). Beyond 2000: Science education for the future.London: King’s College

National Research Council (1996).*National Science EducationStandards.*Washington DC: National Academies Press.

National Science Teachers Association (NSTA). (2003). *Inquiring safely: A guide for middle school teachers*. Arlington, VA: NSTA.

Park, R. (2000). Voodoo *Science.*New York, NY: Oxford UniversityPress

Popper, K.R. (1963). Conjectures and refutations: The growth of scientific knowledge.London: Routledge.

Sagan, C. (1996). *The Demon-Haunted World. Science as a Candlein the Dark.*New York, NY: Ballantine Books.

Schwartz, R.S. & Lederman, N.G. (2002). “It’s the nature of thebeast”: The infl uence of knowledge and intentions on learningand teaching nature of science. *Journal of Research in ScienceTeaching, 39,* 205-236.

Shapin, S. (1996).The scientific revolution. Chicago: University of Chicago Press.

Solomon, J., Duveen, J., & Scot, L. (1994).Pupils’ images of scientific epistemology.International Journal of Science Education, 16, 361–373.

Songer, N.B., & Linn, M.C. (1991). How do students’ views of science influence knowledge integration? *Journal of Research in Science Teaching, 28*(9), 761-784.

Suparno, P.. 2005. *MiskonsepsidanPerubahanKonsepPendidikanFisika.* Jakarta: PT. GramediaWidiasarana Indonesia._. 2014. Misconceptions about science. http://undsci.berkeley.edu/article/000/whatscience01

VALIDITY OF LEARNING MODEL FOR IMPROVING JUNIOR HIGH STUDENTS' ARGUMENTATION SKILLS AND SCIENCE CONCEPT UNDERSTANDING

Rini N. Astuti[1] , Suyono[2], Mohamand Nur[3]
S3 UNESA Science Education
e-mail address: rini.nafsiati@gmail.com

ABSTRACT

Argumentation is a very important process in leaning science. Learning science that involve argumentation can train students to be able to scientifically argue about a concept, defend their arguments, and refuse others by giving supporting evidence also logical reasons. From few researches been done, obtained that learning which involve argumentation can improve students' argumentation skills and concept understanding. This research used to get learning model that can improve junior high students' argumentation skills and science concepts understanding. A model that developed is focusing on 4 aspects of argumentations skills are, (1) deciding claim, (2) giving supporting evidence according to the claim, (3) organize reason, (4) organize counter-argument. This model is developed based on validation result by science learning expert through Focus Group Discussion (FGD) program. Two results obtained from that program. First, the developed model has a goal to increase argumentation and science concept understanding. Second, learning syntax (teacher and student-activities) consist of five phases, which are orientation, exploration, pre-argument, argument and counter-argument, and last reflection.

Keyword: learning model, argumentation skills, concept understanding

Introduction

Argumentation skill is an important skill that must be developed in science teaching in Junior High. According Duschl (2008) argumentation in learning is a process that involves students in complex scientific practice in developing, maintaining, and rejected the claim of knowledge supported by evidence and reason. Zemba-Saul (2009) states that learning involves argumentation will give students the opportunity to practice using the idea or notion by arguing scientifically. Students practice using the idea or notion by arguing scientifically through activities such as make the argument, maintaining the arguments, and rejected the argument. Students which are trained to make the argument, maintaining the arguments, and rejected the argument will be used to think logically (sense) of knowledge claim so they will have better argumentation skills and understanding concepts.

A research by Kuhn (1993) found that First and Second year of Junior High students experiencing difficulties in formulating arguments and determine the evidence that supports the argument about the phenomenon that is close to daily life. Kuhn also found students still have difficulty in showing relevant evidence which could support the argument. Other studies have also been carried out by Osborne *et al.* (2004) showed the students have not been given the opportunity to be involved in the process in drafting claims, determining the evidence, preparing reason to support the claim. The main emphasis in Junior High science learning process is the transfer of knowledge from teacher to students and discussed without involving argumentation skills in expressing and idea or ideas.

As well as preliminary research that has been done by Astuti and friends (2013) on students at one of Junior High school in Malang, East Java, it is found that the students ability to determine the claim, evidence, preparing reasons to support the claim, and arrange counter-argument still low. Each of these indicators obtained scores of 35.35%; 30.41%; 25.67%; and 20.25%. The obtained results showed that students have not been given the opportunity to express idea or ideas through argumentation skills. The learning process is still being dominated by memorizing information, students have not been given the opportunity to define the claim, evidence, preparing reasons to support the claim, and arrange counter-argument. This is seen in the passivity of students in submitting and responding an idea or ideas. Even when students are given a problem, they are hard to provide reasons that supported by evidence. Therefore, it is needed a learning model that gives students the opportunity to express an idea or ideas in solving problems through the activity of determining the claims, evidence, prepare supported reasons, and preparing counter-argument so that be able to increase Junior High School students' understanding of science concepts.

Content and Methods

According to Jimenez *et al*. (2000) that science leaning that gives students the chance to involve in scientific argumentation can be seen from two sides. First, learning involves argumentation gives students opportunity to socially interact to justify and defend an argument. Second, learning involves argumentation can develop the ability to think through the preparation of a claim that is supported by the evidence. Another opinion, Erduran &Jimenez-Aleixandre (2008) states that learning science that involves argumentation emphasize on the preparation of scientific knowledge through the activities of students' thinking. Furthermore, Erduran and Jimenez-Aleixandre states that learning science that trains students to argue would give students opportunity to justify the proposed knowledge claims supported by relevant evidence to develop argumentation skills and higher level thinking skills.

Cross *et al*. (2008) expressed the importance of learning science by involving arguments. According to Cross *et al*. (2008) argument is an important way in teaching logical thinking (makes sense) so that students' understanding of the concept becomes better. Students' concept understanding becomes better when students have to prepare knowledge claim with supported evidence, maintaining an argument, and rejected another argument. Arguments supporting Erduran *et al*. (2004) stated that the ability to argue science learning is an important capability to be developed. This is caused by three factors: (1) learning using argumentation can improve students' understanding of concept, (2) Learning with argumentation can develop higher level thinking process through the activities of students social interaction with language media in defending the claim, and (3) to train students prepare scientific arguments supported the relevant evidence.

Learning model that aims to improve the argumentation skills and understanding of chemical concepts have been developed by Chin and Osborne (2010) in chemistry learning in junior high school, which is a QA model (Question Argumentation). QA model is a model of argumentation learning that focused on the mechanism of potential step preparation argument process. Potential step process of preparing arguments purposed in the model QA are the steps (stages) that must be passed by students in preparing arguments to explain the idea that the claims supported by evidence that have been compiled can be justified.

Mechanism of potential step in the QA model consists of three main steps, namely the step of pre arguments (prepare questions), make the argument (to answer questions and prepare an explanation), and combine contra idea. Activity in pre arguments steps include (1) student is given an explanation of the definition of a claim, evidence, and arguments as well as how to make the argument correctly; (2) students are asked to determine a claim by choosing one of two different charts/graphics; (3) students are requested to draft questions related to two different graphic phenomenon given, (4) students are given some of statements of evidence that can be used to support selected claims; (5) student asked to determine which evidence can be used to support a claim that has been compiled. Second step in the QA model, (1) Students in small groups consisting of four students to discuss the claim, (2) students explore ideas with one another about the evidence that can be used to support the claim, (3) students preparing reasons to explain that chosen evidence can support the claims, (4) students discuss about their argument to explain the idea. Third step of the QA model is students combine different ideas into a formal argument and propose it to be a theory.

QA model has several advantages, (1) provides potential steps in the argument preparation, (2) provide students the opportunity to have dialogue interactions about the ideas, both with teachers and friends, and (3) significantly improve argumentation skills and understanding of the concept. Although learning model QA is more emphasized on the second step, that is the step to make the argument (to answer questions and arrange explanation) in step 3 and 4, but QA model still has some drawbacks, there are (1) do not provide steps to explore the concept before the process of preparing arguments, (2) do not provide counter-argument step (make the opposite argument), and (3) do not provide reflection step to provide feedback on the arguments that have been prepared by students.

Simon *et al.* (2008) developed a learning strategy of argumentation skills in Junior High School science content. The strategy focuses on four learning steps, (1) explains the meaning of the argument, (2) making the argument, (3) develop counter-argument, and (4) reflection. The results showed an increase in students' ability to argue scientifically and reflection step is an important step in argumentation learning. Reflection step is important because it provides feedback on the arguments that have been prepared by students and determine changes in the students' position after learning the argumentation skills.

Based on the advantages and disadvantages of QA models described above, then the model will be further developed with consideration of concept exploration steps and counter-argument steps expressed by Dawson and Venville (2010), reflection step as revealed by Simon *et al*. (2008) so that can improve their argumentation skills and students' concept understanding. The development of this model is expected to produce a learning model that can improve argumentation skills and understanding of the science concept in junior high school.

The method used to design a learning model consists of two stages. First stage is the preliminary stage. The preliminary stage consists of two activities: (1) conduct a study of literature to study the theories and concepts of science teaching that involves argumentation skill, and (2) conduct a preliminary test to obtain preliminary data on the ability of students' argumentation skills on material changes in physics and chemical also the implementation of science learning in junior high school. Based on the results of these two activities is drafted initial product draft or Learning model design which will be developed further during development stage.

Second stage is model development stage. In this stage, learning model draft will be validated by experts in science teaching in order to obtain a valid model. Model validation process through Focus Group Discussion (FGD) using model books and learning CDs that contains samples of the developed learning model and assessment sheets. Result of the assessment of the experts allows three things: first, the assessment result indicates that the developed components in the model is valid or feasible or can be used. Second, the assessment result indicates less valid or can be used with a revision. If so, then the developed model design needs to be revised on the experts' advices. Third, the assessment result shows that the components of the developed model are not valid or cannot be used, so that the model needs to be revised and validated again by the experts.

Results and Discussion

The results obtained in the preliminary stages is a hypothetical model, the model of learning that can improve argumentation skills and understanding of the science concept of junior high school students. Based on Arends (1997) that is learning model has four special characteristics which are not owned by any particular strategy or procedure. The fourth special feature, namely: (1) the objectives to be achieved; (2) the premise of what is to be achieved in learning and how students learn to achieve the learning objectives; (3) teaching activities that are necessary so that model can be implemented successfully; (4) learning environment which is needed to achieve the learning objectives. The next step, hypothetical learning model has been formulated validated through Focus Group Discussion. The results obtained from the FGD is a hypothetical learning model formulated to improve argumentation skills and understanding of science concept in junior high school students can be used with some revisions. The results of model validation with revision are as follows.

Objectives Learning Model

The purpose of learning model development is to improve the argumentation skills and junior high school students' understanding of science concepts.

Teaching Activities Required To Model can be implemented with Success

Activities required in the implementation of learning model are the activity of teachers and students that are described in the form of syntax. According to Arends (1997) learning syntax is a whole stages to do by the teachers and students during learning. Stages in the argumentation skills learning model is as follows.

The first stage is orientation. Orientation phase aims to focus attention by demonstrating the events that are often encountered in daily life to stimulate curiosity and cause a problem that need to be solved by determining initial claims. Orientation phase supported by Piaget's theory of development. Piaget stated that the formal operational stage (from the age 11 years onwards) a child capable of to think abstract, for example thinking about the idea and think through various alternative solutions to problems. According to Arends (1997) there are certain things from the syntax of a learning model will have similarities with other learning models.

The second phase is exploration. Exploration phase aims to provide students the opportunity to explore the concept to justify the initial claims by looking for evidence that supported the claim. Activities undertaken by students are doing practical work and digging through chemistry’s teaching materials class 7 of Junior high school students provided. This stage is supported by Piaget's theory of cognitive development that the activities factor (physical experience) can increase the speed of students’ knowledge development (Woolfolk, 2009). Another opinion that support is Suyono and Harianto (2011) study will be more successful if coincides with the students’ cognitive development. Students should be given the opportunity to conduct experiments with physical objects which are supported by peer interaction.

The third stage is pre-argument. Pre argument is the stage that gives students the opportunity to do discussions with members of the group to discuss the results of the preparation of initial claims, evidence has been obtained, compiling reasons for initial claims and prepare counter-argument in diagram form of the argument. This stage is supported by Jonassen and Kim (2010) students must be given the opportunity to make the argument to externalise the rational idea or ideas supported by evidence and reason. If students are doing the activities above, students will be trained to give explanation to other students about the idea or ideas that can improve the understanding of the concept.

The fourth stage is argument and counter-argument. Counter-argument and argument stage are aims to provide students with an opportunity to develop the argumentation skills by conducting a class discussion about the results of the preparation of an argument diagram. The fourth stage is supported by the opinion of Aydeniz *et al.* (2012) which states that through social interaction and communication in arguments preparation, evidence, and reason through discussion can improve students’ argumentation skills and understanding of the chemistry concept of chemistry.

The fifth stage is reflection. Reflection phase aims to provide an assessment and feedback on the process of argument and argument diagram preparation. Simon *et al.* (2008) stated that at the end of the lesson the teacher can ask the argument changes understanding experienced by students through a reflection on the process of discussion in formulating arguments to solve problem.

Conclusions

The result of the model validation through Focus Group Discussion (FGD) is a learning model to enhance the skills of argumentation has five stages of learning. Those five stages of learning are orientation, exploration, pre argument, arguments and counter-arguments, and reflection. Five stages in learning the syntax is expected to improve the argumentation skills and understanding of science concepts of Junior High School students.

References

Arends, R. I. 1997. *Classroom Instruction and Management.* New York: McGraw-Hill Companies.

Astuti, R.N., Suyono., & Nur, M,. 2013. Studi Pendahuluan Pengembangan Model Pembelajaran untuk Meningkatkan Keterampilan Argumentasi dan Pemahaman Konsep Kimia Siswa. *Artikel, Prosiding Seminar Nasional Pendidikan Sains*, PPs Unesa: Surabaya.

Aydeniz, N., Pabuccu, A., Cetia, S., P, and Kaya, E. 2012. Argumenation and Students' Conceptual Understanding of Properties and Behaviors of Goses. *International Journal of Science and Mathematics Education* .2012.

Chin, M., & Osborne, J. 2010. Supporting Argumenation Through Student's Question: Case Studies in Science Classroom. *Journal of The Learning Science*, 19(2), 230 – 284.

Cross, D. Taasoobshirazi, G., Hendricks, S, and Hickey, D. 2008. Argumentation, A Strategy for Improving Achievement and Revealing Scientific Identities. *International Journal of Science Education*, 30 (6), 837-861.

Dawson, M., V, and Venville, G. 2010. Teaching Strategies for Developing Students' Argumenation Skills About Socioscentific Issues in High School Genetics. *Journal of Research Science Education*. 40(2),133 – 148.

Duschl, R. A. (2008). *Quality argumentation and epistemic criteria*. Argumentation in Science Education: Perspectives from Classroom-Based research. Dordrecht: Springer.

Erduran, S., Simon, S., & Osborne, J. 2004. TAPping Into Argumenation: Development in The Application of Toulmin's Argumen Pattern for Studying Science Discourse. *International Journal of Science Education*. 88(6), 915 – 933.

Jimenez-Aleixandre, M., Rodriguez, A., & Duschl, R. (2000). "Doing the Lesson" or "doing science": argument in high school genetics. *Journal Science Education*, 84(6), 757-792.

Jonassen, H. D. and Kim, B. 2010. Arguing to Learn and Learning to Arque: Design Justification and guidelines. *Journal of Education Teaching Research Development*. 58 : 439 – 457.

Khun, D. 1993. *Science as Argumen*: Implication for Teaching and Learning Science Educatian. 77(3),319 – 337.

Osborne, J.,Erduran, S., & Simon, S. 2004. Enhancing the Quality of Argumenation in School Science. *Journal of Research in science Teaching,* 4 (10), 994 – 1020.

Simon, S., Erduran, S., & Osborne, J. (2008). Learning to teach argumentation: Research and development in the science classroom. International journal of *Science Education*, 28(2-3), 235-260.

Suyono dan Harianto. 2011. *Belajar dan Pembelajaran. Bandung*: Remaja Rosdakarya

Woolfolk, Anita. 2009. *Educational Psychology Bagian Pertama*. Yogyakarta: Pustaka Pelajar.

Zemba-Saul, C., 2009. Learning to Teach Elementary School Science as Argument. *Journal Science Education*, 2(4), 1-34.

STUDIES OF USE HYDROGEN PEROXIDE (H_2O_2) OXIDIZING TO REDUCTION CYANIDE LEVEL IN WASTEWATER

Muntasir[1] , M. Sjahrul[2] , Muhammad Zakir[2], Indah Raya[2]

[1]Graduate Student Faculty Hasanuddin Makassar South Sulawesi

[2]Lecturer in the Graduate Faculty Hasanuddin Makassar South Sulawesi

Email : munbasrypps@yahoo.com

ABSTRACT

Has done conducted research studies the use of oxidizing hydrogen peroxide (H_2O_2) to the reduction of cyanide levels in the wastewater. Parameters measured were the optimum concentration of hydrogen peroxide, pH optimum, optimum contact time between Hydrogen Peroxide with wastewater in reducing the cyanide content. Cyanide obtained from steam distillation of liquid waste and assay using 0.02N silver nitrate. Variations in the concentration used was 100 ppm, 200 ppm, 300 ppm, 400 ppm and 500 ppm; pH variation is (7, 8, 9, 10 and 11) and the variation of contact time are: 30, 60, 90, 120 and 150 minutes. The results showed early treatment of cyanide content of 50.22% w/w and experienced a reduction after the addition of H_2O_2 concentration of 100 ppm, 200 ppm, 300 ppm, 400 ppm and 500 ppm; variations in pH is 7, 8, 9, 10 and 11 and the variation of contact time are: 30, 60, 90, 120 and 150 minutes. The optimum treatment is the optimum concentration of H_2O_2 at 500 ppm with a reduction in levels of 36.40% w/w, pH Optimum pH 8 with reduced levels of 40.91% and an optimum contact time at 60 minutes with a reduction in levels of 37.09% w/w.

Keywords: Cyanide, Hydrogen peroxide, steam distillation. 0:02 N silver nitrate

INTRODUCTION

Environmental pollution due to the use of cyanide (CN-) in the form of sodium cyanide, potassium cyanide and cyanide expanding in line with the increase in the quantity of use of cyanide in an industry that is not matched with the appropriate waste treatment process. Metal plating industries, synthetic fibers, mining and refining of metals generate waste containing cyanide that is harmful to humans (Dasha, R, R., et. All., 2009).

Demand for sodium cyanide and potassium cyanide worldwide is approximately 360,000 tonnes per year of which approximately 120,000 tonnes or one-third is used in the recovery of gold and silver, and about 90% or 450 of the operating gold production significantly around the world currently use cyanide for gold extraction and silver (Mudder, T, I., Botz, M.M 2004). Cyanide is considered among the most toxic compounds and is classified as a hazardous material with the characteristics of acute or chronic toxicity to humans and nature (Deveci, H., et.all. 2006). Used by various industries, especially chemical synthesis plant (nylon, fibers, resins, and herbicides), metallurgical processes (extraction of gold and silver) and plating and surface finishing (Mudder, 2004; Yeddou. AR 2010).

Cyanide (CN) is a constituent chemicals toxic (harmful) commonly contained in B3 waste, including toxic super category. Cyanide and cyanide salts provide rapid toxic effect, in doses of 60-90 mg can cause human death (Manahan, SE, 1989). Limitation of the maximum content of cyanide in the wastewater is allowed dispersed into the environment must be less than 0.05 ppm (PP No. 74 Tahun 2001 dan KLH. 2004). In the gold mining environment, including pollutants CN important because it is used as a key ingredient in the processing of gold so that wasted a lot of waste containing CN and can spread to the surrounding environment through the flow of water and the creatures living in it. (Hidayati, et al., 2009). The gold mining industry, including in Pongkor, compound sodium cyanide (NaCN) is used as a solvent to take the gold metal from rock ore mining results (Sutoto. 2006). Tailings PT Antam Pongkor CN was found to contain up to 0.77 mg kg-1, river water contains 0.14 mg l-1 and stream sediments containing 0.72 mg kg-1 CN. PT Antam Cikotok tailings were found to contain 0.12 mg kg-1 CN. The cyanide pollution does not rule out the possibility of spreading to residential environment and contaminate ground water used by the community. While the danger threshold CN content in drinking water is only 0.005 mg /L (Hidayati, N., et al., 2008).

Research on removal of cyanide from a gold mine tailings has been tested on a laboratory scale with a technique constructed wet land in aerobic and anaerobic by Loredo, 2002; Alvarez et al., 2004 in (Yani. 2012) and requires a long time. Cidu et al. (2011) reported on the processing of tailings with cyanide concentration of approximately 60-400 ppm can be lowered by raising the pH to 8-11, so that the cyanide down to less than 0.5 ppm within a few months. Making gold through leaching with cyanide has a percent gold recovery of over 90% (Smith and Mudder, 1991). Because of the high percent recovery by using cyanide gold miners causing many people began to turn to this method, there is even artisanal miners who use cyanide to process the waste material gold mining with mercury. It turns out this residual material processing give satisfactory results. (Pitoi, M. et al., 2008)

The use of cyanide (CN) in the gold extraction process can cause water pollution, poisoning and death to catch fish resources. Simbolon research results (2010) showed CN content in the liver was higher (6.0 to 18.0 ppm) compared with organ meat (4.2 to 8.5 ppm) (Simbolon. D., 2010). Research free removal of cyanide from an aqueous solution by oxidation with hydrogen peroxide (H_2O_2) is catalyzed by activated carbon-coated copper. Effect of initial molar ratio, copper-coated amount of activated carbon, pH and temperature on the removal of cyanide have been investigated. This process seems to be very interesting because cyanide removal rate is very fast, the reaction using a metal catalyst dissolves and consumes only hydrogen peroxide as chemical products (Yeddou, AR, et.all. 2011). The synergistic combination of hydrogen peroxide and hypochlorite ions in the water to the establishment of transitional high oxidizing species singlet oxygen ($^1O_2$), which is effective in the oxidation of free cyanide (CN-) in water (Teixeira et. All. 2013). Research Sinbuathong states Deletion cyanide (CN-) of wastewater laboratory using sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(OCl)_2$) was performed on reaction time of 30 minutes, the optimum dose and chemical costs NaOCl and $Ca(OCl)_2$ vary depending the initial cyanide concentration (Sinbuathong, N. 2000).

Awan. M.A (2004) Research tannery wastes containing high COD (3413 mg / L) is oxidized independently with three oxidant aqueous hydrogen peroxide, sodium hypochlorite and calcium hypochlorite at different temperatures and duration of the reaction. Calcium hypochlorite oxidant potential and reduce COD to 76% and calcium hypochlorite is the most efficient among the three oxidants. Tangkuman (2008), studied the effect of the concentration of cyanide in gold production. The results showed that the concentration of cyanide effects in the production of gold. Cyanide with 100 ppm cyanide significantly different compared with the 200, 400 and 600 ppm in the recovery of gold. Based on statistical analysis, cyanide with a concentration of 400 ppm is the best in the production of gold.

Based Riyanti Research (2010) tapioca starch wastewater treatment using chlorination process with $Ca(OCl)_2$ shows that prior to the chlorination process, the cyanide content was 51.77 mg / L, while after the chlorination process at the optimum condition (weight $Ca(OCl)_2$ 5 mg, pH 8, and the contact time of 1 hour), obtained the cyanide content of 30.08 mg / L with 41.88% decrease effectiveness. Referring to the results of previous studies, in this study will look for a method or an effective way to reduce the levels of cyanide in the waste, so the waste cyanide from mining and processing of gold using cyanide can be minimized and reduce environmental pollution. Required a waste management not only reduces pollutants but also converts pollutants into non-toxic. Materials used to treat waste is expected to easily obtainable and inexpensive material that reaches industries for waste handling costs.

METHODOLOGY

This research is a laboratory experiment, include: distillation cyanide, treatment parameters by testing the optimum treatment concentration, pH and contact time by the addition of oxidizing Hydrogen Peroxide (H_2O_2). Descriptive analyzes were performed in the tabulation of results and graphs the results of each treatment.

A. Equipment and materials Research

Equipment and materials research include: oven (Memmert), analytical balance (Ohauss), a tool of the glass (pyrex), Magnetic Stirer models 04802-02, pH meter, glass tools, Steam destilation set (pyrex), Elektromantel (Barnstead Electrothermal), burette (Taytec UK), frezeer (Panasonic), pH paper (Merck), clamps and the stand, spray bottle, pint flask of 500 mL, 1000 mL of distilled water pumps. NaCN (Merck), NaCl (Merck), NH3 (Merck), NaOH (Merck), KCN (Merck), K2CrO4 (Merck), AgNO3 (Merck), KI (Merck), H_2O_2 (Merck), Ca (OCL) 2 (Merck), Aquadest, NaOH 2.5%, NaOH 1 N,, NH4OH 10%. , KI 5% and AgNO3 0:02 N

B. Preparation of standard solution of cyanide;

Cyanide standard solution prepared by dissolving 2.5 g KCN with distilled water in a 1 L flask, then right up to the mark diluted measuring, then shaken. The solution is stored in a brown bottle closed. and assayed once a week;

C. Method Acquisition distillate Cyanide

Samples were prepared by dissolving cyanide KCN as much as 25 mg in 500 mL of distilled water in a flask, then the sample cyanide pH was measured before and after treatment. Furthermore, 500 mL sample of cyanide inserted into the distillate flask, then the steam distillation run for 5 hours at temperatures above 100^{o}C and steam distillation process is carried out to obtain a volume of 100 mL. The distillate is collected in erlenmeyer.

D. Preliminary Determination of Cyanide Content

Results obtained distillate volume of approximately 100 mL accommodated in erlenmeyer and added 7 ml of 2.5% NaOH. Furthermore shaken with the aid of magnetic stirrer and into the distillate is added NH_4OH 10% as much as 8 mL and 5 mL of 5% KI. The solution was titrated using 0.02 N $AgNO_3$ to form a white precipitate.

E. Determination of Optimum Conditions with Hydrogen Peroxide (H_2O_2)

1) Determination of Optimum Weight H_2O_2
A total of five erlenmeyer containing 100 ml of liquid waste containing cyanide is added to a certain concentration of H_2O_2 (100, 200, 300, 400, and 500 ppm). The mixture was stirred at 120 rpm for 60 minutes with a magnetic stirrer until a homogeneous solution. Solution determined cyanide content of each treatment. Cyanide content indicates the optimum condition.
2) Determination of Optimum pH.
A total of five erlenmeyer containing 100 ml of liquid waste containing cyanide was added H_2O_2 with a particular concentration (optimum concentration) and then the pH was adjusted by the addition of NaOH using the method Jar Test in order to obtain a solution with a specific pH (7, 8, 9, 10, and 11) , The mixture was stirred at 120 rpm for 60 minutes with a magnetic stirrer with a magnetic stirrer until a homogeneous solution. The solution is then determined cyanide content of each treatment. Cyanide content indicates the optimum condition.
3) Determination of Optimum contact time.
A total of five erlenmeyer containing 100 mL of waste containing cyanide is added to a certain concentration of H_2O_2 (optimum concentration). the pH of the solution was adjusted by adding NaOH using Jar Test in order to obtain a certain pH (pH optimum). Each mixture is stirred for a certain time (0 minutes; 30 minutes; 60 minutes; 90 minutes; 120 minutes and 150 minutes) with a magnetic stirrer until a homogeneous solution. The solution is then determined cyanide content of each treatment. Cyanide content indicates the optimum condition.

RESULTS AND DISCUSSION

Optimum concentration of Hydrogen Peroxide (H_2O_2)

The initial content of cyanide effluent is equal to an average of 52.00% w / w. High cyanide content of this potentially large in the pollution of the water environment. The cyanide content also has passed the threshold set by the Ministry of Environment of 0.5 mg / L (Ministry of Environment). Determination of cyanide by administering varying concentrations of H_2O_2 can be seen in Table 1. Each 100 mL of liquid waste is added H_2O_2 with particular concentration gives the percentage decrease in the levels of cyanide.

Table 1 Percentage Reduction CN levels before and after the addition of Hydrogen Peroxide (H_2O_2) with a concentration of 500 ppm (%)

Treatment	**Titration**	**Volume (mL)**	**Percent concentration (% w/w)**	**Percentage Reduction CN (% w/w)**
CN Without the addition and treatment as early levels	Titration 1	9.7	50.44	50.44
	Titration 2	9.8	50.96	50.96
	Titration 3	10.5	54.60	54.60
	Mean	10	52.00	52.00
Addition of Hydrogen Peroxide (H_2O_2) concentration of 500 ppm	Titration 1	3.0	15.60	34.84
	Titration 2	3.0	15.60	35.36
	Titration 3	3.0	15.60	39.00
	Mean	3	15.60	36.40
Addition of Hydrogen Peroxide (H_2O_2) concentration of 400 ppm	Titration 1	3.4	17.68	32.76
	Titration 2	3.5	18.20	32.76
	Titration 3	3.7	19.24	35.36
	Mean	3.53	18.37	33.63
Addition of Hydrogen Peroxide (H_2O_2) concentration of 300 ppm	Titration 1	3.8	19.76	30.68
	Titration 2	4	20.80	30.16
	Titration 3	3.8	19.76	34.84
	Mean	3.87	20.11	31.89
Addition of Hydrogen Peroxide (H_2O_2) concentration of 200 ppm	Titration 1	4.4	22.88	27.56
	Titration 2	4.0	20.80	30.16
	Titration 3	4.7	24.44	30.16
	Mean	4.37	22.71	29.29
Addition of Hydrogen Peroxide (H_2O_2) concentration of 100 ppm	Titration 1	5.4	28.08	22.36
	Titration 2	5.0	26.00	24.96
	Titration 3	5.2	27.04	27.56
	Mean	5.20	27.04	24.96

In Figure 1 shows the percentage levels of CN with Addition of Hydrogen Peroxide at various concentrations. A reduction in the levels of cyanide by the addition of Hydrogen Peroxide (H_2O_2) can be seen in the Figure 1. Each 100 mL of liquid waste is added Hydrogen Peroxide with particular concentration gives the percentage decrease in the levels of cyanide. The decrease or reduction of cyanide levels with the addition of Hydrogen Peroxide with a concentration of 100 ppm, 200 ppm, 300 ppm, 400 ppm and 500 ppm. Cyanide content is reduced because it has reacted with hydrogen peroxide to form CNCl. The more the addition of peroxide, the greater hdirogen cyanide which react to form

CNCl so that the content of free cyanide contained in the liquid waste is reduced. Initial cyanide content of hydrogen peroxide without the addition of 52.00 % w/w and the content of the smallest on the addition of hydrogen peroxide with 500 ppm cyanide content of 36.40%. The optimum condition is achieved by the equilibrium between the amount of hydrogen peroxide is added to the cyanide contained in the waste.

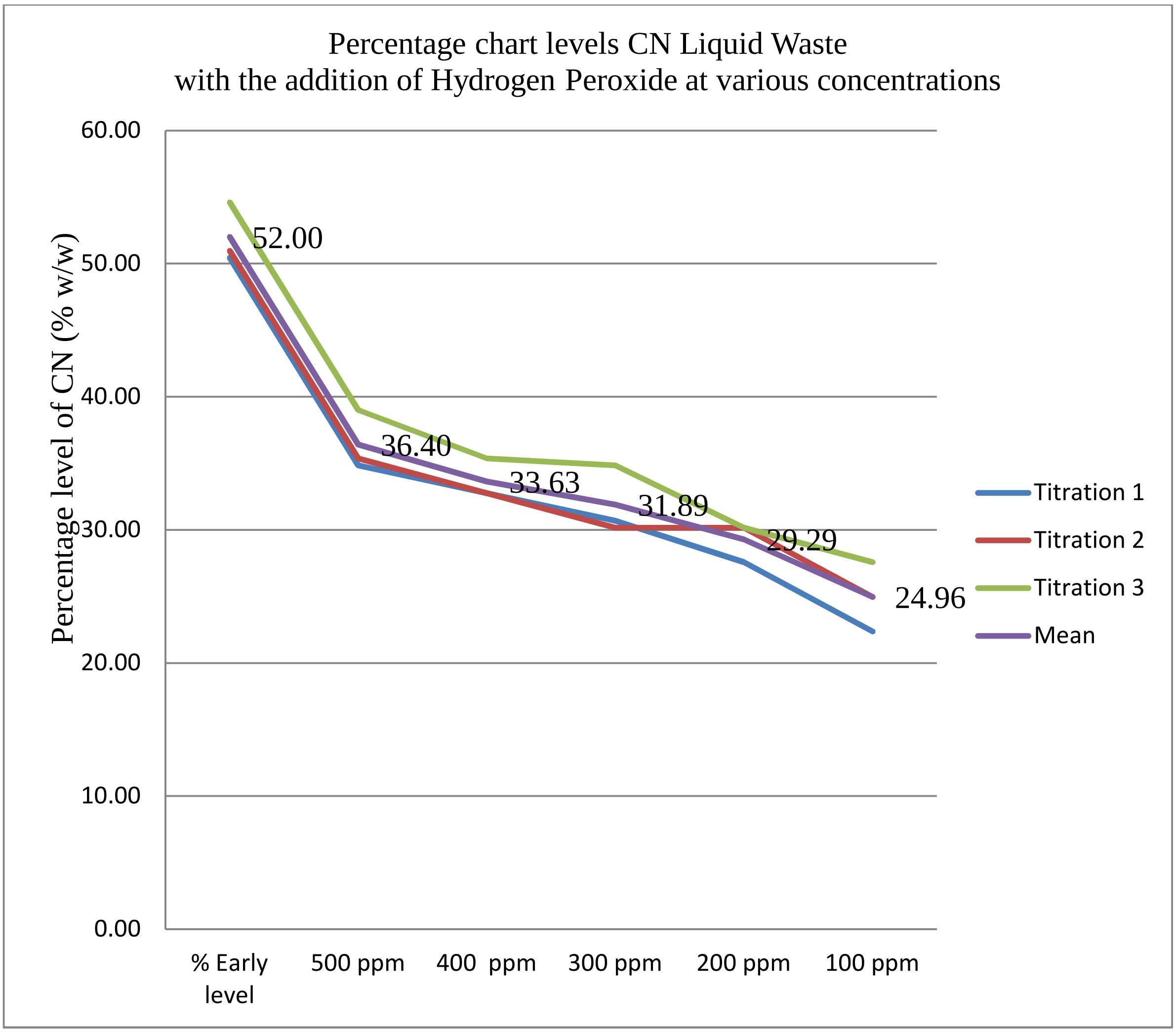


Figure 1. Graph Percentage degree of CN with Addition of Hydrogen Peroxide (H_2O_2) in various concentrations

Optimum pH the Hydrogen Peroxide (H_2O_2)

Next is the determination of cyanide with the pH variation when reacted with Hydrogen Peroxide to reduce the cyanide content in the liquid waste. Hydrogen cyanide oxidation process with peroxide is affected by pH. If the reaction is carried out with an acidic pH, the reaction will be slow but at alkaline pH the reaction will take place rapidly. pH influence on changes in the content of cyanide waste can be seen in Table 2. Each 100 mL of liquid waste is added Hydrogen Peroxide (H_2O_2) with the optimal concentration and a certain pH gives the percentage decrease in the levels of cyanide.

Table 2 Percentage of CN levels before and after the addition of Hydrogen Peroxide (H_2O_2) with a concentration of 500 ppm at pH variation (%)

Treatment	Titration	Volume (mL)	Percent concentration (% w/w)	Percentage Reduction CN (% w/w)
CN Without the addition and treatment as early levels	Titration 1	9.7	50.44	50.44
	Titration 2	9.8	50.96	50.96
	Titration 3	10.5	54.60	54.60
	Mean	10	52.00	52.00
Addition of Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 7	Titration 1	2.7	14.04	36.40
	Titration 2	3	15.60	35.36
	Titration 3	2.8	14.56	40.04
	Mean	2.83	14.73	37.27
Addition of Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8	Titration 1	2.2	11.44	39.00
	Titration 2	2.0	10.40	40.56
	Titration 3	2.2	11.44	43.16
	Mean	2.13	11.09	40.91
Addition of Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 9	Titration 1	2.0	10.40	40.04
	Titration 2	2.3	11.96	39.00
	Titration 3	2.4	12.48	42.12
	Mean	2.23	11.61	40.39
Addition of Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 10	Titration 1	3.2	16.64	33.80
	Titration 2	3.5	18.20	32.76
	Titration 3	3.7	19.24	35.36
	Mean	3.47	18.03	33.97
Addition of Hydrogen Peroxide	Titration 1	3.7	19.24	31.20
	Titration 2	3.6	18.72	32.24
	Titration 3	3.8	19.76	34.84

(H_2O_2) concentration of 500 ppm pH 11	Mean	3.70	19.24	32.76

Subsequent determination of the variation of the pH when reacted with hydrogen peroxide to reduce the cyanide content. The oxidation process is influenced by pH. pH influence on changes in cyanide content of wastewater. A total of 100 ml of liquid waste cyanide by the addition of 500 ppm of hydrogen peroxide at a certain pH obtained the cyanide content as in figure 2. It appears that the decline cyanide content at pH 8 and pH 9.The more alkaline cyanide solution, the reaction between the hydrogen peroxide more quickly . The smallest cyanide content obtained at pH 8 with decreased levels of 40.91% w/w. The optimum condition is achieved because the reaction takes place at a pH of 8 was the maximum. proper pH allows the hydrogen peroxide to react perfectly with cyanide contained in the liquid waste.

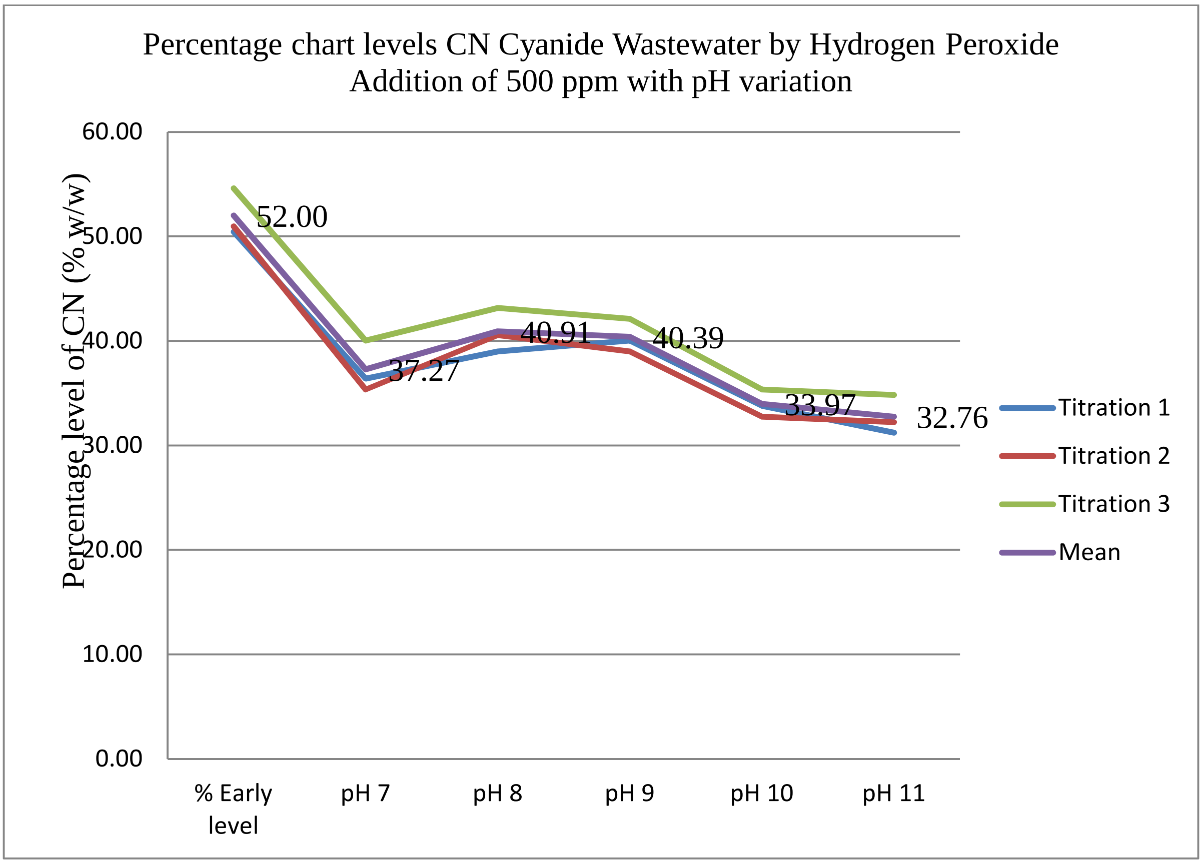


Figure 2. Graph Percentage degree of CN with Addition of Hydrogen Peroxide (H_2O_2) at pH variation

The optimum contact time Hydrogen Peroxide (H_2O_2)

After determination of the optimal concentration of Hydrogen Peroxide and the optimum pH is also determined by administering cyanide assay variation of the contact time between the waste cyanide Hydrogen Peroxide can be seen in Table 3. Each 100 mL of liquid waste is added Hydrogen Peroxide to the concentration optimal, optimal pH and specific contact time gives the percentage decrease in the levels of cyanide.

Table 3. Percentage of CN levels before and after the addition of Hydrogen Peroxide (H_2O_2) with a concentration of 500 ppm, pH 8 and variation of contact time

Treatment	Titration	Volume (mL)	Percent concentration (% w / w)	Percentage Reduction CN (% w/w)
CN Without the addition and treatment as early levels	Titration 1	9.7	50.44	50.44
	Titration 2	9.8	50.96	50.96
	Titration 3	10.5	54.60	54.60
	Mean	10	52.00	52.00
Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 0 minutes	Titration 1	3.6	18.72	31.72
	Titration 2	3.5	18.20	32.76
	Titration 3	3.6	18.72	35.88
	Mean	3.57	18.55	33.45
Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 30 minutes	Titration 1	3.7	19.24	31.20
	Titration 2	3.7	19.24	31.72
	Titration 3	3.9	20.28	34.32
	Mean	3.77	19.59	32.41
Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 60 min	Titration 1	2.9	15.08	35.36
	Titration 2	2.9	15.08	35.88
	Titration 3	2.8	14.56	40.04
	Mean	2.87	14.91	37.09
Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 90 minutes	Titration 1	3.6	18.72	31.72
	Titration 2	3.5	18.20	32.76
	Titration 3	3.5	18.20	36.40
	Mean	3.53	18.37	33.63
Hydrogen	Titration	4.0	20.80	29.64

Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 120 minutes	1			
	Titration 2	4.1	21.32	29.64
	Titration 3	4	20.80	33.80
	Mean	4.03	20.97	31.03
Hydrogen Peroxide (H_2O_2) concentration of 500 ppm pH 8 Contact time 150 minutes	Titration 1	4.6	23.92	26.52
	Titration 2	4.3	22.36	28.60
	Titration 3	4.4	22.88	31.72
	Mean	4.43	23.05	28.95

The determination of the variation of contact time when reacted with hydrogen peroxide to reduce the cyanide content. A total of 100 ml of liquid waste cyanide by the addition of 500 ppm of hydrogen peroxide at pH 8 with a certain contact time obtained the cyanide content as in Figure 3. It is seen that a decrease in the cyanide content at the optimum concentration, pH optimum and a certain contact time.

In Figure 3 shows the contact time of 0 minutes to 150 minutes. The longer the contact time, the interaction between waste cyanide with optimal concentrations of hydrogen peroxide and an optimum pH the better. Thus correcting lebh perfect. Thus more and more waste water cyanide reacts with hydrogen peroxide will reduce the cyanide content. The cyanide content is obtained with a contact time of 60 minutes with decreased levels of cyanide amounted to 37.09% w / w.

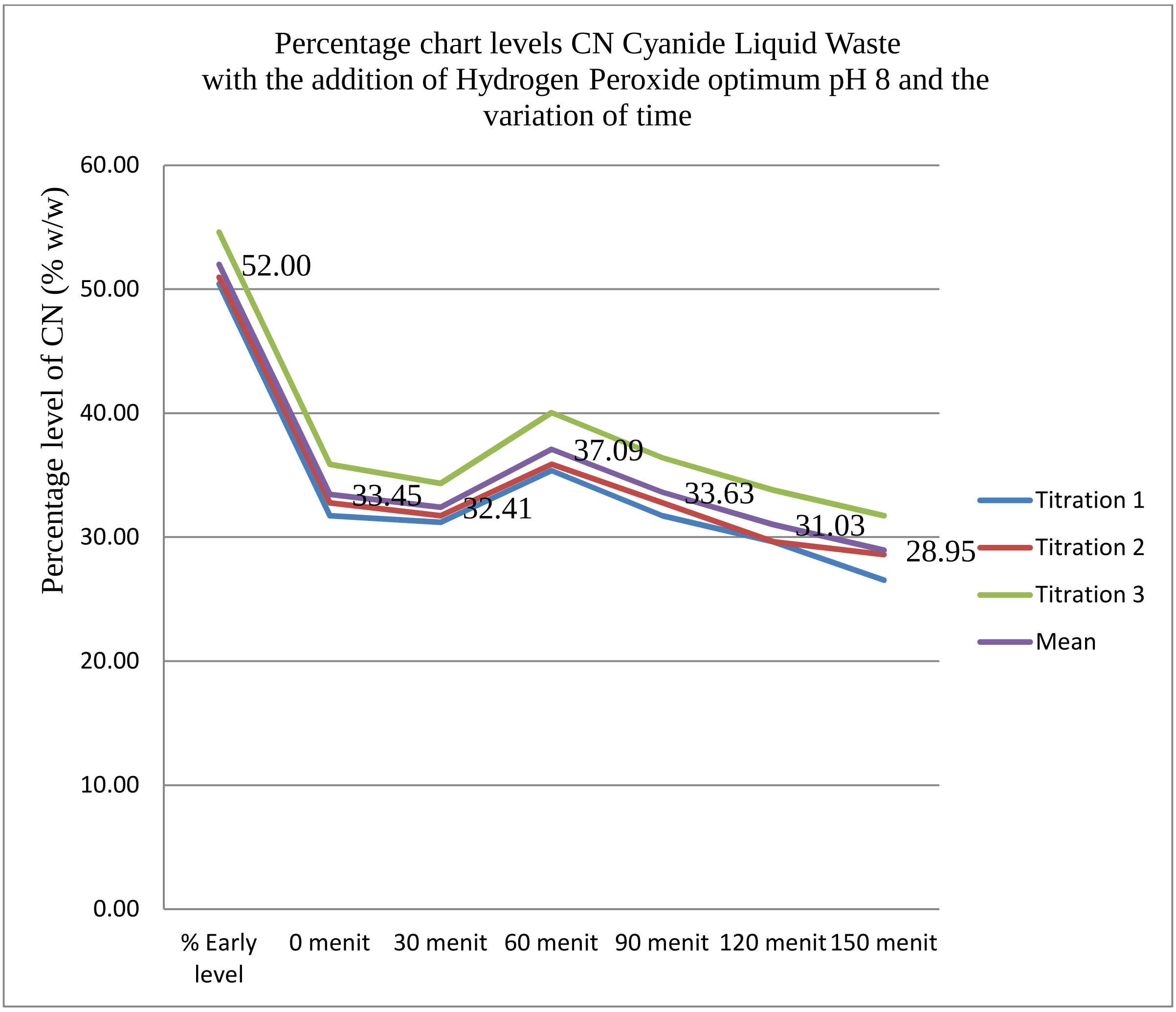


Figure 3. Percentage Graph CN Content with Addition of Hydrogen Peroxide (H_2O_2) in the optimal pH with a certain contact time

CONCLUSION

1. The content of the initial cyanide waste water without the addition of hydrogen peroxide (H_2O_2) of 52% w/w
2. The optimum concentration of hydrogen peroxide in reducing the cyanide content obtained at a concentration of 500 ppm addition of 36.40% w/w
3. pH optimum hydrogen peroxide in reducing the cyanide content obtained at pH 8 amounted to 40.91% w/w
4. The contact time of the hydrogen peroxide in reducing the cyanide content obtained at a contact time of 60 minutes amounted to 37.09% w/w

ACKNOWLEDGEMENTS

Acknowledgements to the Directorate General of Higher Education Ministry of Research, Technology and Higher Education on Graduate Education Scholarship Assistance Home Affairs (BPP-DN) and the leadership of the graduated Hasanuddin university, head of the faculty of Mathematics and natural sciences Hasanuddin University on Facilities and Equipment for research.

REFERENCE

Awan. M. A. 2004. Reduction of Chemical Oxygen Demand from Tannery wastewater by oxidation. (*EJEAFChe) Electronic Journal of Environmental, Agricultur and Food Chemistry* **3** (1) : 625-628

Cidu, R., Pelo, D.S., Frau. F. 2011. Impact of gold mining on the aquatic system: a case study at Furtei (Sardinia, Italy). *Mine Water – Managing the Challenges. IMWA* : 575-580

Dash, R, R., Gaur, A., Balomajumderb, C. 2009. Cyanide In Industrial Wastewaters and Its Removal: A Review on Biotreatment. *Journal of Hazardous Materials* **163** : 1–11

Dash. R. R., Balomajumder. C., Kumar. A., 2009. *An Overview of Removal Methods of Cyanide from Industrial wastewater*. The International Congress on Civil Enginering.

Deveci, H., Yazıcı, E.Y., Alp, I., Uslu, T. 2006. Removal of Cyanide from Aqueous Solutions by Plain and Metal-Impregnated Granular Activated Carbons. *Int. J. Miner. Process.* **79** : 198–208

Hidayat, D. 2011. Effects of Cyanide In Fotoreduksi Hg (II) Catalyzed TiO2. *Molecules*, **6**. (1) : 40-45

Hidayati, N., Juhaeti, T., Sharif, F. 2008. Potential Hiperakumulasi Saccharum spontaneum In Medium Tailings Contaminated Cyanide. *Biota*. **13** (2): 97-105.

Hidayati, N., Juhaeti, T., Sharif, F. 2009. Mercury and Cyanide contaminations In Gold Mine Environment and Possible Solution of Cleaning Up by Using Phytoextraction. *Hayati Journal of Biosciences* **16** (3): 88-94

Ministry of Environment. 2004. *Decree of the Minister of the Environment No. 202 of 2004, regarding Standard of Waste Water Enterprises and or activity Mining Gold Ore and Copper Or*. Jakarta: 1-10

Mudder, T, I., Botz, M.M. 2004. Review Cyanide And Society: A Critical Review. *The European Journal of Mineral Processing and Environmental Protection***.** **4** (.1), : 62-74

Manahan.S.E. 2009. *Toxicological Chemistry*", Lewis Publishers, Inc. Michigan 1989.

Pitoi, M. M., A. D. Wuntu and H. S. J. Koleangan. 2008. cyanide detoxification in gold mining tailing using sodium metabisulphite ($Na_2S_2O_5$) and hydrogen peroxide (H_2O_2). *Chem. Prog.* **1**, (1)

Riyanti, F., Praise Lukitowati, P., Afrilianza. 2010. Chlorination Process To Lose Cyanide Content and Value KOK In Tapioca Starch Wastewater. *Science Research Journal* **13** (3 (C))

Simbolon. D., Simange. SM, and SY Wulandari 2010. The content of Mercury and Cyanide in fish caught from Kao Bay, North Halmahera. *Marine Science*. **15** (3): 126-134

Sinbuathong, N., Kongseri, B., Plungklang., and Roj Khun-anake. 2000.Cyanide Removal from Laboratory Wastewater Using Sodium Hypochlorite and Calcium Hypochlorite *Kasetsart J. (Nat. Sci.)* **34** : 74 – 78

Sutoto. 2006. Assessment of Effect of Oxidation H202 and Y Irradiation In Sodium Cyanide Compounds. *Results and Activities PTLR*

Teixeira, L. A. C., Arellano, M.T. C., Sarmiento, C. M., Yokoyama, L., Araujo, F. V da F. 2013. Oxidation of cyanide in water by singlet oxygen generated by the reaction between hydrogen peroxide and hypochlorite. *Minerals Engineering* **50–51**, : 57–63

Yani, M., Hand, D.M. 2012. Isolation degrading bacteria cyanide from gold mining tailings. *J. Tech. Ind. Pert*. **21** (3): 176-185

Yeddou. A. R., Chergui. S., Chergui. A., Halet, F., Amaouche Hamza, A., Nadjemi, B., Ould-Dris.A., Belkouch. J. 2011. Removal Of Cyanide In Aqueous Solution By Oxidation With Hydrogen Peroxide In Presence Of Copper-Impregnated Activated Carbon *Minerals Engineering* 24 : 788–793

Yeddou. A. R., Nadjemi, B., Halet, F., Ould-Dris, A., Capart, R. 2010. Removal of cyanide in aqueous solution by oxidation with hydrogen peroxide in presence of activated carbon prepared from olive stones. *Minerals Engineering* 23 : 32–39

THE EFFECT OF APPLICATION OF 5E LEARNING CYCLE MODEL COMBINED NUMBERED HEAD TOGETHER (NHT) TOWARD CHEMISTRY LEARNING OUTCOMES ON THE SUBJECT OF SALT HYDROLYSIS IN XI SCIENCE STUDENTS AT SENIOR HIGH SCHOOL 1 TANAH GROGOT ACADEMIC YEAR 2014/2015

Yuni Kurnia[1], Usman[2], Ratna Kusumawardani[3]

[1] *Mahasiswa Prodi Kimia FKIP Universitas Mulawarman*

[2] *Staff Pengajar Prodi Kimia FKIP Universitas Mulawarman*

[3] *Staff Pengajar Prodi Kimia FKIP Universitas Mulawarman*

ABSTRACT

This study aims to determine the effect of application of 5E learning cycle model combined numbered head together (NHT) toward chemistry learning outcomes on the subject of salt hydrolysis in XI science students at Senior High School 1 Tanah Grogot academic year 2014/2015. The method is used in this study is experimental method. Samples were students of class XI Science 4 as an experimental class-treated with 5E learning cycle model combined numbered head together (NHT) and the students of class XI Science 3 as control class treated with direct instructional models. Obtaining the average value of 84,4 post-test experimental class and control class 73,8. Data analysis process two groups using t-test results obtained 3,24 t_{test} and t_{table} at 5% significance level of 1,67, then $t_{calculation} > t_{table}$. The results of this study indicate that there are. The effect of the 5E learning cycle model combined numbered head together (NHT) toward chemistry learning outcomes on the subject of salt hydrolysis in XI sains students at Senior High School 1 Tanah Grogot academic year 2014/2015.

Keywords : 5E learning cycle Model Combined Number Head Together (NHT) and Learning Outcome

INTRODUCTION

Some models of learning that are considered capable of making students more passion for learning in the classroom, more active, able to develop the mindset and maximize learning outcomes, among others, is a 5E learning cycle model and learning model Numbered Head Together (NHT). Research on the 5E learning cycle model already been done before, among others by Asiyah (2013), states that this learning model encourages students to engage actively ask, answer, work on the problems and discussions in groups to solve problems. Group discussions help students solve problems by exchanging information.

Besides learning 5E learning cycle model, another learning model that can affect learning outcomes and student activity is a learning model Numbered Head Together. Learning model Numbered Head Together is one type of structural model of cooperative learning in the learning process which prioritizes cooperation to achieve learning objectives.

This is according to research conducted by Kartikasasmi (2012), that the learning model Numbered Head Together affects creativity and student learning outcomes for the better. The combination of two learning models are intended to complement each other's deficiencies learning model. The structure is developed in this the learning model Numbered Head Together is as an additional alternative to the stages of 5E learning cycle model. Two of these models are also suitable for improving the spirit of the students in the learning process in the classroom so that the material presented will be easily accepted in particular to the subject salt hydrolysis. Salt hydrolysis cubject is that contains a calculation in which students must understand clearly and also contains concepts that are difficult to remember the students with direct instructional model.

Based on the background described above, the author is interested in conducting research on the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.

RESEARCH METHODS

This study was conducted in Senior High School 1 Tanah Grogot in May 2015. The research is a research experiment. The sample in this study were students of class XI Science 3 totaling 32 students and XI Science 4 totaling 32 students. Sampling was done by purposive sampling technique. Considerations in this sampling is the advice from a chemistry teacher at Senior High School 1 Tanah Grogot which is proved to capture the score of these two classes of documentation which is then tested by t test and F test. Research instruments is used is a test that has 6 questions at each meeting and also the observation sheet to measure student activity.

Data analysis

Before the treated (Pramudjono, 2005)

Documentation obtained in the form of data score obtained from the subject teachers of chemistry at Senior High School 1 Tanah Grogot processed by the statistics which used the F test to determine a class derived from the variances homogeneous or heterogeneous followed by t-test to determine whether there is difference in absorption of students in two classes which will be used as a sample

$$F_{calculation} = \frac{S_1{}^2}{S_2{}^2}\ where S_1{}^2 > S_2{}^2$$

If $F_{calculation} < F_{table}$ then the sample is considered homogeneous.
If $F_{calculation} \geq F_{table}$ then the sample is considered heterogeneous.

T-test is then performed to determine whether there is a difference absorption students

a. If the sample (variances) of both samples is homogeneous, the formula will be:

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$S = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

b. If the sample (variances) of both samples is heterogeneous, the formula will be

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^{\ 2}}{n_1} + \frac{S_2^{\ 2}}{n_2}}}$$

Notes:

$\overline{X_1}$: the average score of grade XI Science 3

$\overline{X_2}$: the average score of grade XI Science 4

n_1: the sample numbers of grade XI Science 3

n_2: the sample numbers of grade XI Science 4

S_1: the standard deviance of grade XI Science 3

S_2: the standard deviance of XI Science 4

S: the deviance of combination

Ha and H_0 hypothesis is as follows:

H_0: There are differences in absorption between XI Science 3 and XI Science 4 at Senior High School 1 Tanah Grogot

Ha: There is no difference in absorption between XI Science 3I and XI Science 4 at Senior High School 1 Tanah Grogot

Based on the comparison of the value of the t-calculation and t-table, it can be concluded as follows:

1. If t-calculation > t-table then Ho is rejected and Ha is accepted, which means that there are differences in absorption between XI Science 3I and XI Science 4 at Senior High School 1 Tanah Grogot
2. If t-calculation ≤ t-table then Ho is accepted and Ha is rejected, which means that there is no difference in absorption between between XI Science 3I and XI Science 4 at Senior High School 1 Tanah Grogot.

After treated (Pramudjono, 2005)

Data obtained through achievement test processed by the statistics, which in this case used the t test to compare two average score is the average score of the class that uses a 5E Learning Cycle model combined Numbered Head Together (NHT) and average the value of the class using direct instructional models. Before entering F test and t test, the first step that must formulate hypotheses on Ha and H_0 as follows:

Ha: There is the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.

H_0: There is no effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.

For the t-test can be divided into two groups, namely the variance t test homogeneous and heterogeneous variance t test. Both homogeneous or heterogeneous variance can be seen through the test F (Pramudjono, 2005).

$$F_{calculation} = \frac{S_1{}^2}{S_2{}^2} \; where S_1{}^2 > S_2{}^2$$

If $F_{calculation} < F_{table}$ then the sample is considered homogeneous.
If $F_{calculation} \geq F_{table}$ then the sample is considered heterogeneous.

T-test is then performed to determine whether there is a difference absorption students

a. If the sample (variances) of both samples is homogeneous, the formula will be:

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$S = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2}}$$

b. If the sample (variances) of both samples is heterogeneous, the formula will be

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1{}^2}{n_1} + \frac{S_2{}^2}{n_2}}}$$

Notes:

$\overline{X_1}$: the average score of grade XI Science 3

$\overline{X_2}$: the average score of grade XI Science 4

n_1: the sample numbers of grade XI Science 3

n_2: the sample numbers of grade XI Science 4

S_1: the standard deviance of grade XI Science 3

S_2: the standard deviance of XI Science 4

S: the deviance of combination

Based on the comparison of the value of the t-calculation and t-tabulation, it can be concluded as follows:

1. If t-calculation > t-table then Ho is rejected and Ha is accepted, which means there is the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.
2. If t-calculation ≤ t-tabulation then Ho is accepted and Ha is rejected, which means there is no effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.

RESULTS AND DISCUSSION

Results of Study

1.5.1.1 The Result Before Treatment

Result	**XI Science 3**	**XI Science 4**
Avarege Score	53,4	52,2
$F_{calculation}$	1,75	
$F_{tabulation(5\%)}$	1,84	
$t_{calculation}$	0,30	
$t_{tabulation}$	1,67	

The average score of students before the subject of salt hydrolysis is equilibrium and acid-base in the class of XI Scince 3 is 53.4 and in the class of XI Science 4 is 52.2. Based on table it can be seen that the F_{table} = 1.84 and $F_{calculation}$ = 1.75, so $F_{calculation} < F_{table}$ it can be concluded that the data homogeneous, where as the t test obtained $t_{calculation}$ = 0.30 and t_{table} = 1.67 so $t_{calculation} \leq t_{table}$, it shows that in both classes there is no difference in the ability of absorption before it is treated, then proceed with the study. Based on data analysis can be seen that the results of the study after being given treatment on each sample group, as the following table.

The Result After Treatment

Analisis Data	**XI IPA 3**	**XI IPA 4**
	Direct Instructional Model	5E Learning Cycle model combined Numbered Head

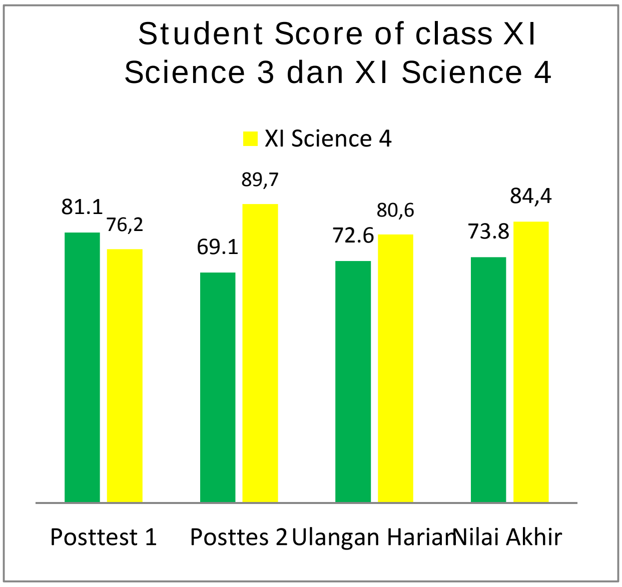
		Together (NHT)
Averege Score	73,8	84,4
$F_{calculation}$	1,26	
$F_{table(5\%)}$	1,84	
$T_{calculation}$	3,24	
t_{table}	1,67	

The results showed that the average student learning outcomes using 5E Learning Cycle model combined Numbered Head Together higher than students who use direct instuctional models. The average score of XI Science 3 is 73.8 and the average score of XI Science 4 is 84.4. Furthermore, teble shows that $F_{calculation}$ = 1.26 and F_{table} = 1.84, so $F_{calculation} < F_{table}$ it can be concluded homogeneous samples. T test calculations obtained $t_{calculation}$ = 3.24 and t_{table} = 1.67 so $t_{calculation} > t_{tabulation}$ the significant level of 5% then H_0 is rejected and Ha accepted. Thus, it can be seen that there is the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015.

Table Percentage 5E Learning Cycle model combined Numbered Head Together

Meeting	Student Activity (%)	Criteria
I	80,5	Good
II	80	Good
Avarege	80,25	Good

Based on the table it can be concluded that the average achievement of the learning process stage activities undertaken by the students has been successful. The posttest results in two meetings and the results of daily tests in class XI Science 4 using a model 5E Learning Cycle model combined Numbered Head Together and class XI Science 3 using direct intructional model can be seen in the following graph.

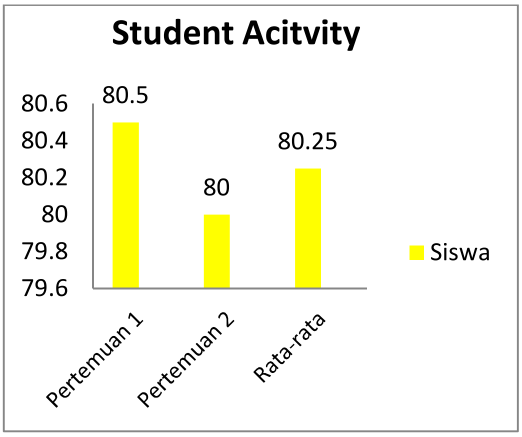


Based on the results of the posttest meeting picture 1 and 2 as well as the daily test class XI Science 3 (direct instructional model) and XI Science 4 (5E Learning Cycle model combined Numbered Head Together) there are differences in learning results clams on the subject of salt hydrolysis.

Posttest and daily test conducted looked for differences in student learning outcomes experimental class and control class. This difference can be seen from the end of the second class XI Science 3 which is value is 73.8 and XI Science 4 is 84.4, indicating that the 5E Learning Cycle model combined Numbered Head Together make student learning outcomes for the better rather than direct learning models.

Based on the results of the calculation of the average score posttest, daily tests and observations made in the experimental class that has been done, that 5E Learning Cycle model combined Numbered Head Together have a positive impact on student learning outcomes, especially material salt hydrolysis.

After statistical data management by using the t test variance homogeneous $t_{calculation} = 3.24$ and $t_{table} = 1.67$ so $t_{calculation} > t_{table}$ the significant level of 5% then H_0 is rejected and Ha accepted. This shows that there is the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015. During the learning process, the observation made by the four observers. Student activity observation results are shown in the following graph:



Student Activity Level image on Application of Learning Model Learning Cycle 5E combined Numbered Head Together (NHT)

Based on the overall Images can be known application of the 5E Learning Cycle model combined Numbered Head Together been implemented properly. The results of observations made on the first day and the second study showed that activity 5E Learning Cycle model combined Numbered Head Together went well and effectively. At the first meeting and the second, the application of the learning model show teacher have been carrying out all stages of the learning that has been developed previously. Based on observations known to the teachers have implemented learning model as a whole stage. The average yield of observation of students known to the student activity by 80.25% with good criteria means the activity of students in the learning process very active role in learning

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the research that has been done, it can be concluded that:

1. There is the there is the effect of application of 5E Learning Cycle model combined Numbered Head Together (NHT) toward chemistery learning outcomes of the subject salt hydrolysis in XI science student at Senior High School 1 Tanah Grogot academic year 2014/2015. The highest student learning outcomes obtained in the experimental class with a value of 84.4, while the control class value is lower at 73.8.
2. Activity of students in the learning 5E Learning Cycle model combined Numbered Head Together (NHT) on the subject of salt hydrolysis is 80.5% with good criteria.

Suggestion

As the end of this study, the authors can be argued as follows:

1. In applying the 5E Learning Cycle model combined Numbered Head Together (NHT) teacher should divide the time in the learning process well, so that students actually take the time to understand the material being studied. Among others on the stage and Head Together Explanation given more time to discuss and think together to explore the ability of students so that students can understand and do well all the questions.

2. Teachers make Learning Cycle 5E models combined Numbered Head Together (NHT) as an alternative model of teaching chemistry in schools in order to improve the quality of student learning outcomes.
3. The more research that is model Learning Cycle 5E combined Numbered Head Together (NHT) on another subject that have similar characteristics with salt hydrolysis.

REFERENCES

Agustyaningrum, Nina. 2010. *Implementasi Model Pembelajaran Learning Cycle 5E untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa Kelas IX B SMP Negeri 2 Sleman*. Jurnal Pendidikan Kimia. Diakses tanggal 15 Maret 2015

Asiyah, Mulyani dan Nurhayati. 2013. *Penerapan Model Pembelajaran Learning Cycle5e Berbantuan Macromedia Flashdilengkapi Lks Untuk Meningkatkan Aktivitas Dan Prestasi Belajar Siswa Pokok Bahasan Zat Adiktif Dan Psikotropika Kelas VIII SMPN 4 Surakarta Tahun Pelajaran 2011/2012.* Jurnal Pendidikan Kimia. Diakses Tanggal 15 Maret 2015

Arikunto, Suharsimi. 1993. *Manajemen Pengajaran Secara Manusiawi*. Rineka Cipta. Jakarta.

Arikunto, Suharsimi. 2009. *Dasar-Dasar Evaluasi Pendidikan*. Bumi Aksara. Jakarta.

Azwar, Saifuddin. 1997. *Metode Penelitian*. Yogyakarta: Pustaka Belajar

Cholistyana, Ika Eliza. 2014. *Pengaruh Model Learning Cycle 5E terhadap Hasil Belajar Siswa Pada Konsep Sistem Ekskresi*. Skripsi. Jurusan Pendidikan IPA UIN Syarif Hidayatullah. Jakarta. Diakses tanggal 15 Maret 2015.

Darsono, Max. 2002. *Belajar dan Pembelajaran*. IKIP Semarang Press. Semarang

Dalyono. 2009. *Psikologi Pendidikan*. Rineka Cipta. Jakarta.

Dimyati, Mudjiono. 2002. *Belajar dan Pembelajaran*. Rineka Cipta. Jakarta.

Djamarah, Syaiful Bahri dan Zain, Aswan. 2006. *Strategi Belajar Mengajar.* Rineka Cipta. Jakarta.

Djamarah, Syaiful Bahri. 2002. *Psikologi Belajar*. Rineka Cipta. Jakarta

Fajaroh dan Dasna. 2008. *Pembelajaran Dengan Model Siklus Belajar (Learning Cycle)*. Jurnal Pendidikan Kimia. Jurusan Kimia FMIPA UM. Malang,. Diakses tanggal 14 Maret 2015

Ibrahim, Muslimin. 2002. *Pembelajaran Kooperatif*. UNESA University Press : Surabaya.

Kartikasasmi, Handini. 2012. *Penerapan Model Pembelajaran NHT dengan Pendekatan Sets pada Materi Cahaya untuk Mengembangkan Kreativitas Sis*wa. Skripsi. Semarang

Kunandar. 2007. *Guru Profesional Implementasi Kurikulum Satuan Pendidikan (Ktsp) Dan Sukses Dalam Sertifikasi Guru*. Rajawali Pers. Jakarta

Kusumawardana, Fauzi Usman Ardhi. 2012. *Implementasi Metode Pembelajaran Drill Sebagai Upaya Meningkatkan Aktivitas dan Prestasi Belajar Mata Diklat Plc (Programmable Logic Control) SMK Muhammadiyah 3 Yogyakarta*. Skripsi. Yogyakarta

Lie, Anita. 2005. *Cooperative Learning : "Mempraktekkan Cooperative Learning di dalam Ruang-Ruang Kelas*". Gramedia. Jakarta

Majid, Abdul. 2013. *Strategi Pembelajaran Remaja.* Rodaskarya. Bandung

Mulyani,Sumantri,dkk.1999. *Strategi Belajar Mengajar*. Depdikbud Dirjen Pendidikan Tinggi.

Nurdiana, Khristiani. *Penerapan Model Pembelajaran Kooperatif tipe Think Pair Share untuk Meningkatkan Aktivitas dan Prestasi Belajar Kimia siswa pokok bahasan Sifat Koligatif Larutan Kelas XII SMA N 1 Tanah Grogot Kabupaten Paser*. Thesis. Samarinda

Pramudjiono. 2005. *Statistika Dasar Aplikasi untuk Penelitian.* FKIP Unmul. Samarinda

Riyanto, Yatim. 2014. *Paradigma Baru Pembelajaran*. Kencana Prenamedia Group. Jakarta.

Sastrawijaya, Tresna. 1988. *Proses Belajar Mengajar Kimia.* Depdikbud. Jakarta.

Sulistiawati, Septiana. 2011. *Penerapan Model Pembelajaran Kooperatif Tipe Make A Match untuk Meingkatkan Hasil Belajar Biologi Siswa di Kelas X SMK Kesehatan Samarinda Tahun Pembelajaran 2010/2011*. Skripsi. Samarinda

Seftiwi, Arsyita. 2014. *Penerapan Model Pembelajaran Kooperatif Numbered Heads Together (NHT) untuk Meningkatkan Hasil Belajar Siswa pada Pokok Bahasan Termokimia di Kelas XI IPA SMA PGRI Pekanbaru*. Skripsi. Pekanbaru

Slameto. 2003. *Belajar dan Faktor-Faktor yang Mempengaruhinya*. Rineka cipta. Jakarta

Sudjana, Nana. 2005. *Penilaian Hasil Proses Belajar Mengajar*. PT. Remaja Rosdikarya. Bandung.

Sukmadinata, Nana Syaodih. 2004. *Landasan Psikologi :Proses Pendidikan.* PT. Remaja Rosdakarya. Bandung.

Sulistyowati, Tri dkk. 2014. *Implementasi Learning Cycle 5e Dilengkapi Worksheet Untuk Meningkatkan Kreativitas Dan Prestasi Belajar Siswa Pada Materi Pokok Hidrolisis Garam Kelas XI IPA 1 Semester Genap Sma Negeri 3 Boyolali Tahun Pelajaran 2013/2014*. Jurnal Pendidikan Kimia

Susanti, Ria Yuli Dkk. 2013. *Pengaruh Penerapan Model Pembelajaran Learning Cycle 5Fase (Lc 5-E) Terhadap Hasil Belajar Siswa Kelas XI IPA pada Materi Termokimia di Sma Negeri 2 Malang.* Jurnal Pendidikan Kimia

Susilo. 2009. *Penelitian Pendidikan*. Poliyama Widya Pustaka. Jakarta

Suyono dan Hariyanto. 2012. *Belajar dan Pembelajaran*. PT. Remaja Rosdikarya. Bandung

Syahdani, Ferdi. 2014. *Perbandingan Hasil Belajar Siswa Menggunakan Model Pembelajaran Kooperatif Tipe NHT dikombinasikan dengan Model Pembelajaran PBL dengan Model Pembelajaran Konvensional di MAN 1 Model Kota Bengkulu.* Skripsi. Bengkulu

Trianto. 2009. *Mendesain Model Pembelajaran Inovatif Progresif*. Kencana Prenada Media Group. Jakarta.

Trianto. 2011. *Model-Model Pembelajaran Inovatif Berorientasi Konstruktivitis*. Prestasi Pustaka. Jakarta.

Wahyuningsih, Tri. 2008. *Peningkatan Hasil Belajar Fisika Melalui Strategi Pembelajaran Inkuiri.* Skripsi. Samarinda

Widyaningsih, Dedeh. 2010. *Perencanaan Pembelajaran Matematika*. Rizqi Press. Bandung

PROSPECTIVE CRITICAL THINKING AND COGNITIVE STUDENTS BASED LEARNING THROUGH INQUIRY

Abdul Hamid
Chemical Education, ,Lambung Mangkurat University
(hamidkimia123@gmail.com)

ABSTRACT

The Study on critical thinking and cognitive prospective students through inquiry-based learning had been conducted. The aim of this study is to determine the critical thinking and cognitive prospects of senior high school students through the free and guided inquiry learning. The data had been gathered by using a quasi-experimental. The firststep of this study was using*nonequivalent control group*that was designed for SMA Negeri 11 to see the prospect of guided inquiry and also student'scognitive and critical thinking.Next step, to improve students' cognitive and critical thinking datagathered from SMA Negeri 1 Banjarmasin students to see prospective guided inquiry and free inquiry. *The comparison between designed pretest-posttest of these 2 groupsanalized.*

The study shows that (1) guided inquiry learning having more prospectcompared to expository learning with value of N-gain 0.71 and 0.62 (2) free inquiry has more prospect in improving critical thinking than guided inquiry with a value of N-gain 0, 48 and 0.47. (3) guided inquiry has more prospect in increasing students' cognitive value compared to free inquiry to the value of N-gain of 0.82 and 0.62.

Keywords: a prospective, critical thinking, cognitive, inquiry.

PRELIMINARY

Human are always challenged to tough and resilient in the face of rapidly world changes. Toughness and tenacity are insufficient if not accompanied with the ability to solve problems. These capabilities requires the ability to think critically. Critical thinking includes measures to evaluate the situation, issue, or argument, and choose the pattern of investigations that yield the best answer (Feldman, 2010). According to Filsaime (2008) a person to be successful in any field, should have the skills to think critically, reason deductively and inductively, criticism and be able to accept ideas from others. The skills of critical thinking is an expectation and an important goal in the desired educational outcome of all human activities.

Based on Permendikbud 81A (2013), the teacher as the facilitator should provide the opportunity for students to play an active role in the learning process both in class and outside of class to train aspects of observing, ask, gather information / experimental, process and communicate informationin order to cultivate critical thinking.

Critical thinking skills can be built when carrying out investigations to find and develop a concept. Investigations can develop thinking skills and cognitive students to look for what must be known and what is unknown, thinking to solve problems, to evaluate what has been done. Critical thinking can be cultivatedthrough an active learning, by giving opportunity for students to learn more actively *(student centered).*

The requirement of critical thinking skills and cognitive development for living seem to be an important thing that should be giving more attention in learning process. According Kitot et al. (2010) suggest a learning process need to encourage students to think critically using the strategy of thinking, such as problem solving, conceptualization and make a decision, it was found on inquiry-based learning. For this requirement it is necessity to investigate the critical thinking and cognitive prospective high school students through inquiry-based learning.

RESEARCH METHODS

The method used is a quasi-experimental research.The firststep of this study was using*nonequivalent control group*that was designed for SMA Negeri 11 to see the prospect of guided inquiry and also student'scognitive and critical thinking. Next step, to improve students' cognitive and critical thinking data gathered from SMA Negeri 1 Banjarmasin students to see prospective guided inquiry and free inquiry. The *pretest-posttest*were designed and*the comparison between pretest-posttest of these 2 groups wereanalized.*

The sample of this research was XI MIA students of SMAN 11 consists of two classes with total of 71 students and X MIA SMA Negeri 1 students consists of two classes with a total of 70 students. The selected sample had been choosen using *purposive cluster sampling technique.*

The classification level of student's critical thinking and cognitive abilities were interpreted using categories in Table 1.

Table 1. Interpretation level critical thinking skills of students

Percentage	**Category**
x ≥ 87.50	Very good
75.00 ≤ x <87.50	Good
62.50 ≤ x <75.00	Enough
50.00 ≤ x <62.50	Less
x <50.00	Very less

Source: Kusumaningsih (2011)

The calculation of N- *gain* values were interpreted to indicate the magnitude of the increase in the cognitive learning and critical thinking skills of students based pretest and posttest scores. According to Hake (1999), the calculation of N *gain* values use the following equation:

$$<g> \; = \; \frac{<G>}{<G>_m} \; = \; \frac{(<S_f> - <S_i>)}{(1 \quad - <S_i>)}$$

Description :
$<G>$ = Average normalized gain
$<G>$ = Average actual gain
$<G>_{max}$ = maximum gain that may occur
$<S_{f}>$ = The average score of the final test
$<S_{i}>$ = average of initial test score

N- *gain* value obtained was interpreted by using categories in Table 2;

Table 2. Interpretation of the value of Ngain

Interval N- *gain*	**Category**
$<g> \geq 0.70$	Height
$0.7\,0 > <g> \geq 0.30$	Moderate
$<g> < 0.3\,0$	Low

Source: Hake (1999)

RESULTS AND DISCUSSION

The result study reveals as follows;

Table 3. Interpretation of *N-gain* critical thinking skills class experiment and control

Classroom	The average *N-gain*	Category
Experiment	0, 71	Height
Control	0, 62	Moderate

The average *of N-gain* values in Table 1 shows that the experimental class has *N-higher gain* compared with the control class. Experimental class increased critical thinking skills greater than the control class after getting the solubility of learning. The average value of *the N-gain* in the experimental class was 0.71 in the high category, while the average value of *N-gain* in the control group was 0.62 in medium category. This suggests that more guided inquiry has future prospects in order to improve students' critical thinking, remembering syntax guided inquiry learning more emphasis on formulating assessment, so that students are accustomed to dealing with problems and critical thinking. This fits to what is disclosed byFilsaime, (2008) that critical thinking ability is to analyze the information and ideas carefully and logically from various point of view. According to Cottrell (2005) critical thinking is a cognitive activities associated with the use of the mind, learning to think analytical and evaluative, use mental processes such as attention, categorization, selection and assessment.

Critical thinking certainly related to students cognitive.The study reveals that the value of student's cognitive development as can be seen in the Table 4;

Table 4. Interpretation of *N-gain* cognitive learning outcomes of students

Classroom	The average *N-gain*	Category
Experiment	0.7 7	Height
Control	0, 67	Moderate

The data shows that cognitive learning outcomes of students for classroom experiments were high while the control classes in medium category, it shows that guided inquiry have greater prospect to improve students learning outcomes.The guided inquiry more accustom students to think. Inquiry learning in harmony with a constructivist approach which emphasizes on the activities of learners maximally to search and find the problem, meaning that inquiry learning puts the learner as a subject in which students find themselves contribute to the core of the subject matter (Hosnan, 2014).

The study also reveals that the guided inquiry learning can improve students' critical thinking and cognitive. Students' critical thinking can affect the cognitive abilities as teaching materials related to abstract concepts, reactions, but it requires an understanding of the conceptual and algorithmic understanding. This is in accordance with the opinion of Timberlake (2012) that the chemistry is the science that studies the composition, structure, properties, and reactions of matter. Chemistry is the science that was developed based on the results of the experiment and the facts that occurred.

At the material solubility and solubility product students are required to understand the principles of solubility, better teaching chemistry implemented to foster the ability to think, work, and scientific attitude and the ability to communicate as an important aspect of students' life skills, thus learning to chemicals should be designed to be able to develop a lot of things wrong which is the ability to think.

Previous experiments showed guided inquiry learning is able to increase critical thinking and students'cognitive then needs to be continued next study how the independent inquiry? to answer that question, we can see the research data in the following table;

generally N- *gain* critical thinking skills students experiment class 1 and 2 are in the medium category. N- average *gain* critical thinking skills experimental class 1 and 2 can be seen in Figure 1.

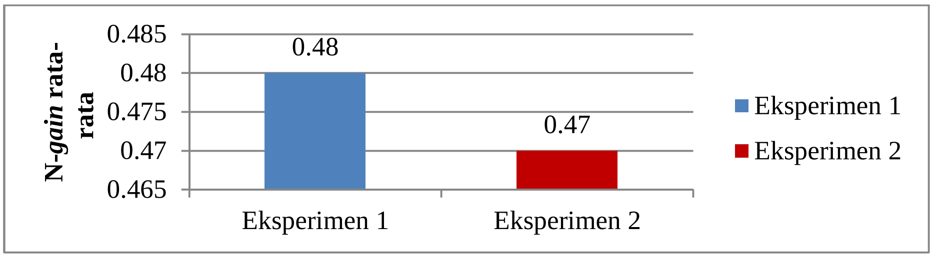


Figure 1. Comparison of the average value of *N-gain* critical thinking skills

Based on the data above the critical thinking skills of students on free inquiry learning (experiment 1) and guided inquiry (experiment 2) both hasmedium category. This indicates that the inquiry learning have the same prospect in improving students' critical thinking. Although the value of the average has little difference.This difference occurs because thefree inquiry is more able to exercise critical thinking skills of students, find and solve problems independently, this ability is more activates the left hemisphere of students which is the realm of critical thinking (Jensen, 2008) high school students are not familiar with the free inquiry so they work more slow and unfocused.

The following figure (fig. 2) shows the learning outcomes of two groups

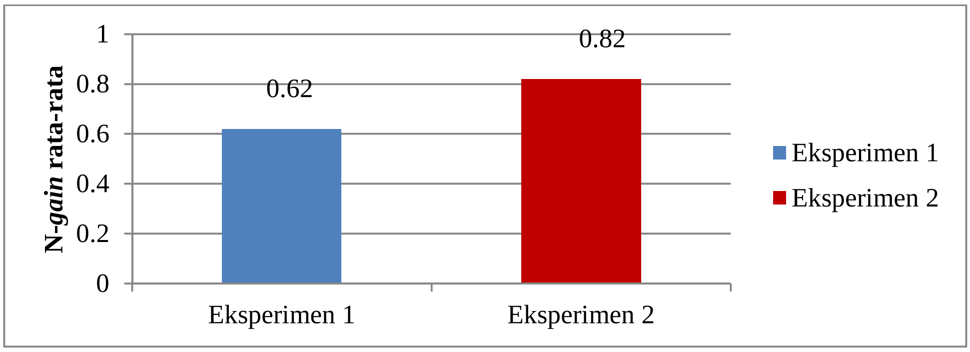


Fig.2 Comparison of the average value of *N-gain* the cognitive outcomes

Figure 2 describesthe increasing of students' cognitiveoutcomes in guided inquiry classes(experiment 2) andfree inquiry classes (experiment 1). The figure shows that guided inquiry classes (experiment 2)is greater than the free inquiry classes (experiment 1). This is due to the students find it easier and accustomed to teacher-led in terms of understanding the concept. According to Putra (2013),in guided inquiry, teachers work actively in helping and guide students in conducting investigations and directing students in discussion. Teachers have an active role in defining the problem and the stages of its solution. Teachers have to concern on teachers' questions and students' multidirectionaldiscussion which leads students to understand the concept. The implementation of guided inquiry at senior high school students has better prospect in terms of cognitive enhancement.

CONCLUSION

Based on the results of the discussion it could be concluded; that (1) guided inquiry has more prospectcompared with free inquiry due to the value of N-gain 0.71 and 0.62 (2) free inquiry has more prospectin improving critical thinking compared with the guided inquiry N-gain value of 0.48 and 0 , 47. (3) guided inquiry has prospectin increasing students' cognitive outcomes compared to free inquiry to the value of N-gain of 0.82 and 0.62.

SUGGESTION

Based on these results to see prospectstudents' critical thinking through inquiry-based learning suggested in the learning process should be provided a longer time.

BIBLIOGRAPHY

Cottrell, S. 2009. *Critical Thinking Skills.* Palgrave Macmillan, London.

Feldman, DA 2010. *Critical Thinking.* Volume 5: *Strategies for Decision Making.* The index, Jakarta.

Filsaime, DK 2008. *Secret Reveals Critical and Creative Thinking.* Achievement Pustakaraya, Jakarta.

Hake, RR 1999. Analyzing Change / gain Scores. *American Educational Research Association's Division D, Measurement and Research Methodology.* Accessed through http://Lists.Asu.Edu/Egi-Bin. On January 11, 2015.

Hosnan. 2014. *Scientific and Contextual Approach in the 21st Century Learning.* Ghalia Indonesia, Bogor.

Jensen, E, (2008), *Brain base learning* (Translation Narulita Conan), Yogyakarta. Publisher Student.

Kitot, AKA, AR Ahmad, AA Seman. 2010. *The Effectiveness of Inquiry Teaching in Enhancing Students' CriticalThinking. Journal of Research and Development in Education.*

Kusumaningsih, 2011. D. *Efforts to Improve Critical Thinking Ability XC Grade Students SMAN 11 Yogyakarta Through PembelajaranMatematika with Contextual Approach Teaching and Learning (CTL) In PerbandinganTrigonometri material.* Bachelor Thesis. State University of Yogyakarta, Yogyakarta.

Permendikbud No. 81A. ***2013.*** *Implementation of the Curriculum.* MenteriPendidikan and Culture of the Republic of Indonesia, Jakarta.

Son, SR 2013. *Based Design Creative Teaching and Learning of Science.* DIVA, Yogyakarta.

Timberlake, KC 2012. *Chemistry: An Introduction to General, Organic, and Biological Chemistry.* Eleventh Edition. Pearson, United States.

THE EFFECTIVENESS OF LIPASE IMMOBILIZATION ON CHITOSAN BEADS CROSS-LINKED BY GLUTARALDEHYDE

Lizma Febrina
Faculty of Pharmacy,Universitas Mulawarman Samarinda
email: lizma@farmasi.unmul.ac.id

ABSTRACT

The effectiveness of immobilizedlipase on chitosan bead with glutaraldehyde as cross-linker compounds has been carried out. This research aims to obtain optimal condition for immobilization of lipase on chitosan bead. Chitosan bead made from chitosan powder by inverse phasemethod. This research started from the optimization process of immobilization for the optimum concentration of glutaraldehyde as cross-linker compounds. Immobilizedlipase on chitosan beads was tested for its activities and stability of re-uses in the hydrolysis reaction of palm oil triglycerides. The optimum concentration of glutaraldehyde is 0,5% (v/v) with immobilization enzyme percentage 84% and specific activities of immobilized of lipase 82 U/g. Immobilizedlipase has lower activities than free lipase.Butit have the relative activity of 70% after 5times of use, while the free lipase enzymes 4% after 5 times of use. This indicates the stability of the re-use of lipase immobilized better than free lipase.

Key words: Glutaraldehyde, Chitosan beads, Immobilized Lipase.

INTRODUCTION

Over the years, awareness of the Green Chemistry concept among the industry players is growing. One of such awareness is the use of environmentally friendly catalysts which are also capable of increasing the energy efficiency during the reaction. This concept has led to the development and use of enzymatic processes. One of the enzymes playing an important role as biocatalyst is lipase.

However, as a biocatalyst, lipase has several drawbacks including high cost of enzyme isolation, instability of enzyme structure to changes in environmental conditions (temperature, pH, ionic strength as well as other disruption) and contamination by the enzyme that makes it incapable of being reused after the reaction is complete (Krajewska, 2004).

One of the attempts to solve the problem is by using the enzyme immobilization technique by attaching the enzyme on a solid support in order to produce an enzyme in a heterogeneous system so that a more heat-resistant enzyme which is more capable of being reused can be obtained, as it will make easier to obtain a more active enzyme once the reaction is complete (Zubriene*et al*., 2003).

Chitosan is known as a solid support ideal for enzyme immobilization thanks to its characteristics including its biodegradability, biocompatibility and capability of being an antibacterial (Wu *et al*., 2001). In addition, chitosan has NH_2 group that is important in the immobilization process. Physical modification of chitosan powder into chitosan beads will be more favorable in terms of reuse effectiveness and thermal stability.

The interaction between chitosan beads and enzymes can be improved by crosslinking chitosan beads with a compound. Glutaraldehyde is a compound that is widely used due to its low cost and relatively quick preparation (Schiffman*et al*., 2007). However, the use of glutaraldehyde as a cross-link compound in immobilization process has to be reconsidered because the very nature of glutaraldehyde can inhibit enzyme activity as it can react with both the enzyme's active sites and sulfhydryl groups.

Therefore, it is interesting to carry out an in depth examination into the effectiveness of lipase immobilization on chitosan beads cross-linked by glutaraldehyde compound. In this study, the effectiveness of immobilization will be examined using the most easily observed basic reaction, namely,palm oil hydrolysis.

METHOD

1. Tools

Glass equipment (pyrex), falcon bottle (50 ml and 15 ml), magnetic stirer, syringe needle (26G), buchner filter, hot plate (Ishtar Hitzstir), burette, micropipette (50-200 µl), digital balancing (Shimadzu Libror EB-303), oven (WTB Binder), pH-meter, Forier transform-infrared Spectrophotometer FTIR (IRPRESTIGE-21), Elisa reader, incubator shaker.

2. Materials

Material that used during research, there are : palm oil (bimoli special), crab shell, pig pancreas lipase enzyme (Merck), whatman paper no.41, filter paper, pH paper, aquadest, n-hexane, ethanol, sodium hydroxide, sodium monohidrogen phosphate, sodium dihydrogen phosphate, copper (II) sulphate, potassium sodium tartat, phenolphthalein indicator, BSA (Bovin Serum Albumin) , Glutaraldehyde, oxalic acid, boric acid, an indicator bromcherosol green-methyl red and acetic acid, all of them used material for pro analyst (p.a).

3. Procedure

a. Isolation ofChitin andPreparation of Chitosan

Isolation of chitin was done through deproteination and demineralization. Deproteination was done by refluxing 50 grams of crab shell powder with 500 mL of NaOH 4% (w/v) for 2 hours at a temperature of 65°C. The reflux result was then filtered and washed with distilled water until neutral pH and was dried in an oven. After deproteination, the process went on with demineralization, in which the residue was mixed with HCl 1M at the ratio of 1:15 and was stirred at room temperature for 3 hours. Next, the mixture was filtered and washed with distilled water until neutral pH. Finally, the residue was roasted and was then called chitin.

Meanwhile, preparation of chitosan was done through deacetylation process, in which 50 grams of chitin was refluxed with NaOH 50% (w/v) with a ratio of 1:10 at a temperature of 100°C for 1 hour. The reflux result was then cooled and filtered until neutral pH. The residue was then roasted, producing chitosan, which would then be characterized.

b. Measurement of protein concentration

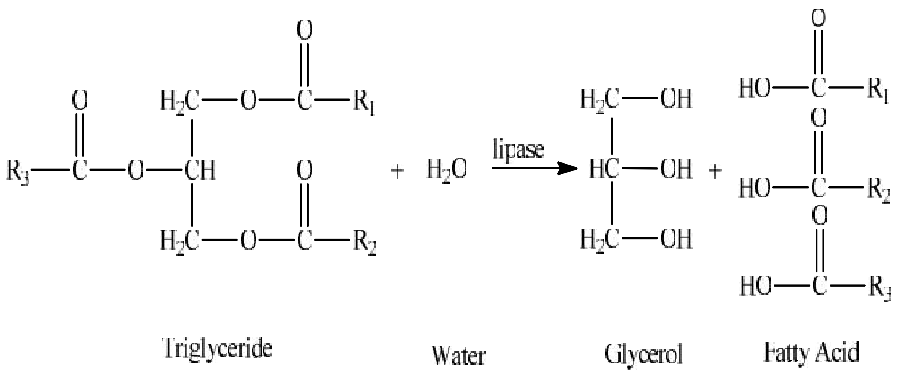
Generation of standard curve started with preparation of standard solutions, bovine serum albumin (BSA), in which BSA standard solution 50 mg/mL was prepared. Diluted standard solution was taken 100 µL, and then 160 µL of biuret reagent was added. Each mixture was kept to stand for 10 minutes, and after that the absorbance was identified at λ 550 nm with a mixture of 100 µL of distilled water and 160 µL of biuret. The results of the absorbance of standard solution were used to generate the standard curve (absorbance vs. concentration).

Measurement of protein concentration was done by adding 100 µL of protein sample to 160 µL biuret reagent. The same step as that on the generation of standard curve was carried out. The protein concentration of sample was determined by inputting the absorbance data of the sample into the equation of the standard curve.

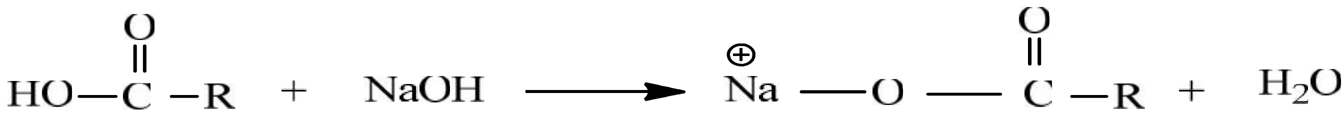
c. Activity test of free lipase enzyme

1 g of palm oil was put in a 10 mL volumetric flask, and 1 µL of water and n-hexane was added up to the mark. The solution was then transferred into a 50 mL falcon bottle, to which 20 mg of lipase was added. The solution was stirred for 5 hours at a temperature of 37°C. To control the enzymatic hydrolysis reaction, palm oil without lipase enzymes was used and the procedure was the same as that in the enzymatic hydrolysis reaction. The results was filtered to separate the enzyme, and to the resulting solution of the reaction, 10 mL of ethanol and 2-3 drops of phenolphthalein indicator were added. Activity was measured through the determination of free fatty acids formed using volumetric method using NaOH 0.05 M standard solution.

One unit of enzyme activity is defined as the amount that causes the conversion of 1.0 micromole (µmole = 10^{-6} mole) of substrate per minute in a state of optimal measurement. The specific activity is the amount of enzyme units per milligram of protein.



fatty acid



Volume of NaOH = x mL

mole of NaOH = (M.V) NaOH

mole of NaOH = mole of free fatty acid

$$\text{Unit Activity} = \frac{(v \quad o \quad N \qquad x\,c \qquad\qquad o \quad N \qquad)\mu}{5\,x\,6 \quad m}$$

$$\text{Specific Activity} = \frac{u \quad a}{m \quad o \quad e\imath}$$

Note: mg of enzyme is obtained from the determination of protein concentration

d. Preparation of *chitosan beads*

Preparation of chitosan beads was done using inverse phase method, that is, by agglomerating the chitosan solution spontaneously in excess NaOH solution (Chiou, 2003). Chitosan solution was made 3% (w/v) in acetic acid 1% (v/v). Chitosan solution was inserted through a syringe needle (26G) into a 250 mL glass beaker containing 100 ml of coagulant (a mixture of 1 M NaOH solution in 26% (v/v) ethanol). The mixture was left for 24 hours, until spherical gels were formed. Gels were then separated by filtration. Then the gel was washed with distilled water until neutral. The neutral chitosan beads were stored in distilled water.

e. Addition of Glutaraldehyde

1 g of wet chitosan bead was added to 3 mL of phosphate buffer pH 6. The concentration of glutaraldehyde used also varied (% v/v): 0; 0.10; 0.20; 0.30; 0.40; 0.50; 0.60; 0.70; 0.80; 0.90 and 1.00). Activation process was done by letting the mixture at room temperature for 10 minutes. After that, the beads were washed with distilled water and were transferred into 3 mL of lipase 1% (w/v) in phosphate buffer. Immobilization was carried out at room temperature for 60 minutes. After that, filtering and washing with distilled water was carried out. Then, the filtrate was analyzed by using the biuret method to determine the amount of immobilized enzyme.

$$\%\text{ of immobilized enzyme} = \frac{a \qquad of\ in \qquad\qquad e\imath \qquad (m\ \ )}{i\imath \qquad a \qquad\quad o\ \ e\imath \qquad (m\ \ )} \times 100\%$$

f. Activity test of immobilized lipase enzyme in hydrolysis

The activity of the resulting immobilized lipase enzyme was tested using the same method to test the activity of free lipase enzyme. The difference lies in the use of immobilized lipase enzyme in place of free lipase enzyme used as biocatalyst in the palm oil hydrolysis.

g. Re-use test of lipase enzyme

Re-use test is a test to determine the life span of enzyme in catalyzing the hydrolysis reaction of palm oil. Re-use test was done by using lipase enzyme immobilized on chitosan beads. In the re-use test, the immobilized lipase enzyme on chitosan beads were separated from the substrate after the reaction was complete, and were reused in a subsequent reaction with the same procedure. To control, free lipase enzyme was used.

RESULTS AND DISCUSSION

a. Isolation of Chitin and Preparation of Chitosan

Isolation of chitin was carried out using No and Meyer method (1989), which consists of two stages: deproteination using a strong base (NaOH) to break the covalent bond between the chitin and the protein, and demineralization using HCl.

The deproteination and demineralization processes yielded chitin weighing 103.57 g or 51.79% of the weight of the crab shell powder. The chitin was successfully transformed into chitosan by removing the acetyl group to form an amine group (NH_2) through the process of deacetylation. The chitin deacetylation was very difficult to carry out perfectly. The yielded chitosan from the chitin deacetylation process weighed 42.35 g and were in yellowish white. The chitosan was then characterized by using infrared spectrometer and the characterization results are shown in Figure 1.

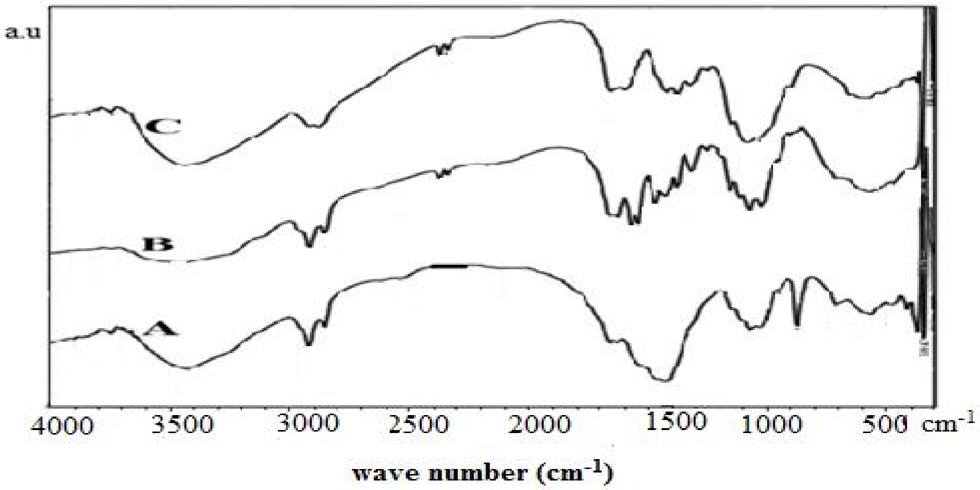


Figure 1. IR Spectra of crab shells (A), chitin (B) and chitosan (C)

Based on the IR spectra, there are differences between the spectra of crab shell powder and that of chitin, seen from the absorption peaks that appear on each spectra as follows:

1. The loss of absorption at wave number 871 cm^{-1} which is Si-C stretching vibration shows the loss of silica mineral due to NaOH treatment.
2. The loss of absorption at wave number 1427 cm^{-1} as a result of the dissolution of metal attached to the peptide group (Cahyaningrum, 2009).
3. The presence of absorption at wave number 1566 cm^{-1} which indicates the presence of the -NH bending vibration in amide. Absorption at this wave number are also the typical characteristic of chitin, that is the presence of -NH in -NH-CO.
4. The presence of absorption at wave number 1627 cm^{-1} which indicate the presence of C=O stretching vibration in the amide.

In the FTIR spectra of chitosan, the absorption band appears almost the same as the FTIR spectra of chitin, but with different intensity, especially at wave number 1627 cm^{-1}, in which the chitosan has a lower absorption intensity. This is because many carbonyl groups are lost due to deacetylation. Results of IR spectra are used to calculate the chitosan degree of deacetylation. According to calculations using the baseline method, the obtained degree of chitosan deacetylation is 76.02%.

b. Hydrolysis activity of free lipase enzyme

The activity of free lipase enzyme was tested in advance through hydrolysis reaction. It aimed to determine whether or not the free lipase enzyme to be used still has hydrolysis activity. Palm oil hydrolysis with a free lipase enzyme produced FFA (free fatty acid) as much as 76.55%, while oil hydrolysis without using lipase produced as much as 7.15% FFA. The free fatty acids formed from the palm oil hydrolysis using free lipase enzyme was substantially more than that without lipase. This indicates that the lipase enzyme used still have catalytic activity.

c. Preparation of Chitosan Beads

Chitosan beads are modified chitosan powder by means of swelling so that the resulting chitosan has larger pore size. Modification by swelling the chitosan powder into chitosan beads does not change the type of functional groups that it is expected that the active sites, in this case, the amine group, in both chitosan powder and chitosan beads are the same.The results are shown in Figure 2.

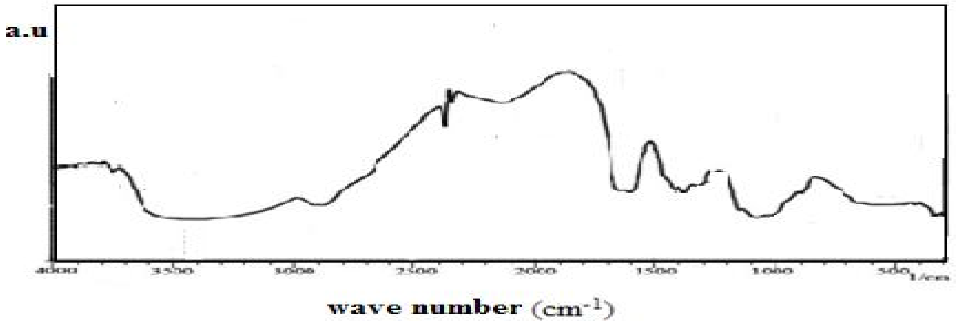


Figure 2. IR Spectra of Chitosan Bead

The result of DD calculation shows that the process of chitosan bead preparation caused an increase in DD into 80.71%. This increase is expected to occur when the chitosan gel interacts with NaOH during the bead formation. At this stage, there is a possibility of further deacetylation process or it can be said that the bead formation process using NaOH is the purification process of chitosan powder.

d. Addition of Glutaraldehyde

Glutaraldehyde is the most frequently used cross-linking compound due to its high activity and because it has an aldehyde group that can form covalent bonds with the amino group on the protein and with NH_2 groups on chitosan beads through the Schiff's base reaction.

Glutaraldehyde has two possible cross links. First, a cross link between the aldehyde end of the crosslinking compound and other amine groups of chitosan (Xu et al., 2001). When this happens, the enzyme is trapped in crosslinking as shown in Figure 2. The second possibility occurs between the aldehyde end and the amine group on the chitosan and the amine group on the enzyme’s protein (Zubriene et al., 2003) as shown in Figure 3.

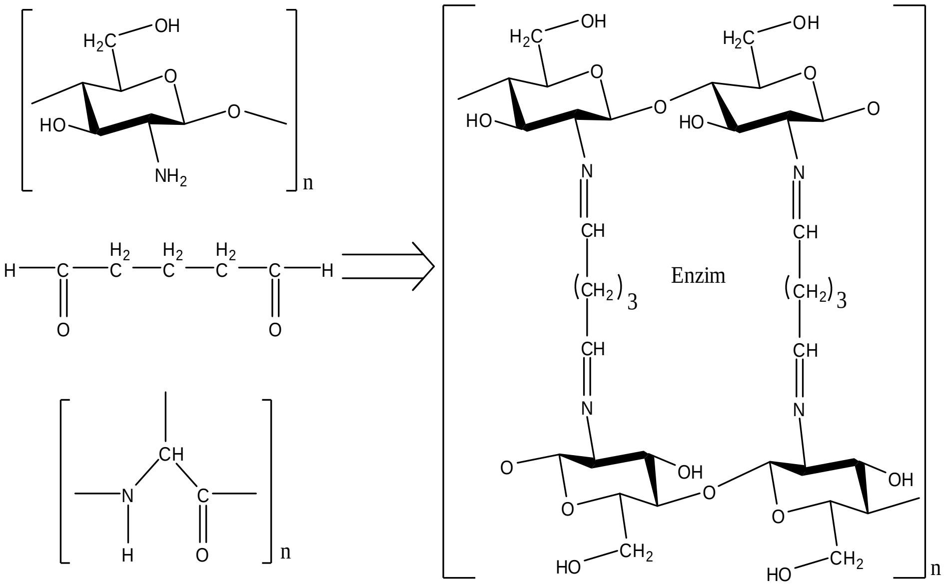


Figure 3. Cross-linking between chitosan molecules

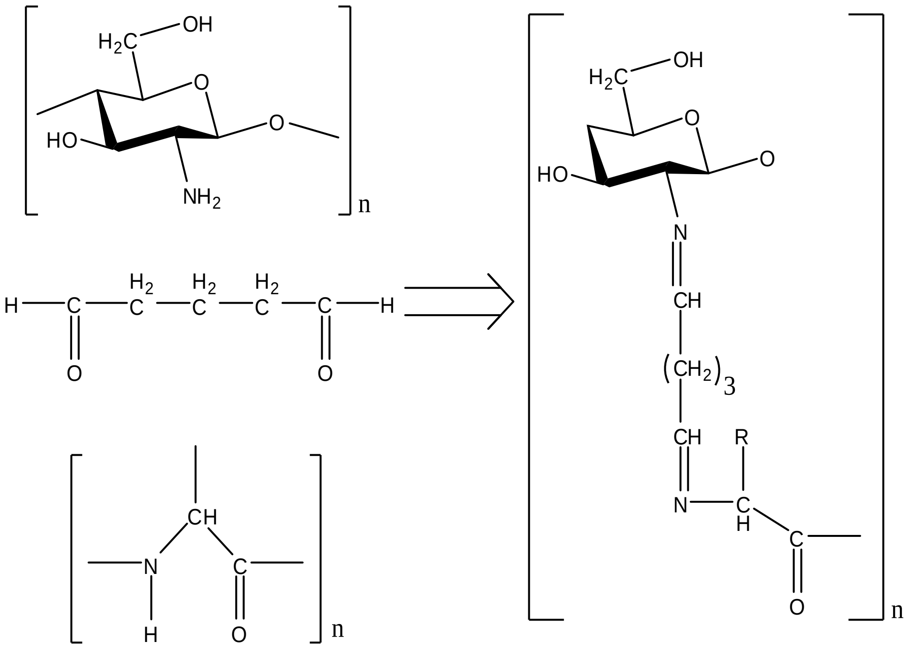


Figure 4. Cross-linking between chitosan molecules and enzyme

The second possibility (Figure 4) is more likely to expect. This is because the enzyme covalently bound to the amine group on the chitosan is more difficult to come apart, making it easier to separate the enzyme with the product at the end of the reaction.

Aldehyde group on the glutaraldehyde is able to not only form a bond with the amine group on the chitosan beads and amine groups on the enzyme but also bind to the other functional groups on the side chain of the amino acid enzyme such as sulfhydryl and hydroxyl groups. Therefore, the concentration of glutaraldehyde should be considered so that it does not bind to the enzyme's active site or to the sulfhydryl group that can make the enzyme denatured. Data of the variation of glutaraldehyde concentrations to the amount of the immobilized enzyme are presented in Table 1.

Table 1. Addition of glutaraldehyde, amount of immobilized enzyme and catalytic activity

Addition of Glutaraldehyde (%)	Percentage of Immobilized Enzyme (%)	Catalytic Activity (U)	Specific Activity (U/g)
0	58	0.028	9.0
0.10	60	0.287	79.0
0.20	71	0.331	80.0
0.30	72	0.336	81.0
0.40	80	0.369	81.5
0.50	84	0.397	82.0
0.60	84.5	0.303	70.9
0.70	83	0.287	71.0
0.80	80	0.276	67.0
0.90	80	0.276	67.0
1.00	77	0.259	64

Table 1 shows that during the direct interaction of chitosan beads with lipase enzyme (without the addition of glutaraldehyde), some lipase enzyme can be immobilized but after the washing, the enzyme lipase fall apart again. This is evident from the small activity. After the immobilization, the immobilized lipase enzyme on chitosan beads is washed with demineralized water until the wash water no longer contains lipase enzyme. This is done in the hope that the lipase, which just sticks and is entrapped on the chitosan beads solid support, can be separated so that lipase immobilization on chitosan beads is a process involving chemical interaction(that is, by the covalent bond).

Table 1 also shows that at a concentration of 0.10-0.60% (v/v), the amount of immobilized enzyme increases. This is due to the increasing number of enzymes that can be cross-linked with chitosan beads by glutaraldehyde. However, at a concentration of 0.70-1.00% (v/v), the percentage of immobilized enzyme decreases.

At a glutaraldehyde concentration of 0.60% (v/v), an interesting trend appears: while the percentage of immobilized enzyme is large, its catalytic activity is small. This is possible because glutaraldehyde binds to sulfhydryl groups (-SH) in enzymes that causes the changes in enzyme conformation.

e. Activity of immobilized lipase enzyme

The effectiveness of the lipase enzyme immobilization can be known through hydrolysis reaction of palm oil. Hydrolysis produces FFA values comparable to lipase activity. From the FFA values in Table 2, it is known that there is activity in the lipase enzyme immobilized on chitosan beads although its activity is smaller than that of the free lipase enzyme.

Table 2. Activity test of immobilized lipase enzyme in hydrolysis

Enzyme Types	Value of FFA (%)	Activity (U)	Specific Activity (U/g)
Free lipase	53.41	0.67	145
Immobilized lipase on *chitosan bead*	22.71	0.39	82

There are several factors that led to the immobilized enzyme activity has been smaller than free lipase enzyme including:

1. Conformational changes that occur due to the particular reaction of amino acids and cross-linking compound added. These conformational changes are caused by changes in the forces determining the enzyme’s overall structure such as electrostatic and van der Walls forcesas well as hydrophobic interactions due to environmental influences during the immobilization process or the addition of molecule in solid support that induces this change (Suhartono, 1989).
2. Glutaraldehyde has the potential to inhibit the activity of lipase in hydrolyzing the oil by reacting with alkoxide ion at serine, which is the enzyme’s active site and sulfhydryl groups on the amino acid cysteine.
3. The lipase enzyme immobilized on the cross-linked chitosan beads has limitation to interact with the substrate as compared with the free lipase enzyme.

f. Reuse Stability of Immobilized Lipase Enzyme

The effectiveness of immobilization can be seen from the reuse in the subsequent reactions. Figure 4 shows that the palm oil hydrolysis using free lipase enzyme as catalyst decreases the FFA drastically in the next use.

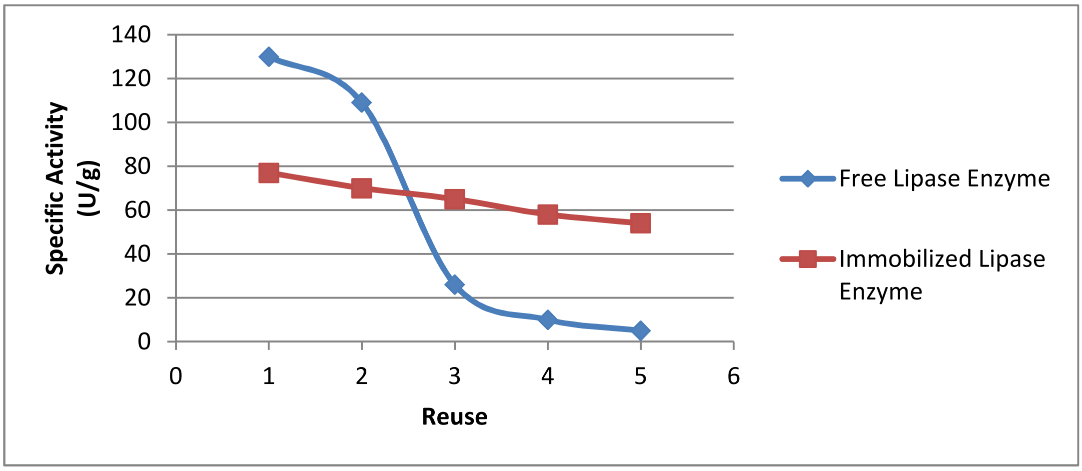


Figure 5. Reuse of free and immobilized lipase enzymes

In Figure 5, it can be seen that the relative activity of free lipase enzyme is 4% after 5 times of reuse. It is obvious that after the first use, the specific activity of the enzyme is recorded at 130 U/g, while after the fifth use,the specific activity is only 5 U/g. However, the immobilized lipase enzyme has a relative activity of 70% after 5 times of use. It is evident from the first usage, where specific activity of the immobilized lipase enzyme is 77 U/g, while after the fifth use, itbecomes 54 U/g.

The relative activity of free lipase enzyme which is smaller than that of the immobilized lipase enzyme is due to a decrease in the yielded FFA as a result of the reduced activity of lipase enzyme in hydrolyzing the palm oil. This could be because the enzyme is difficult to be separated from the product so that the concentration of enzyme that reacts in the next use has been greatly reduced, and that the product has contaminated the enzyme.

CONCLUSION AND RECOMMENDATION

Conclusion

The results shows that the use of glutaraldehyde as a cross-linking compound increases the enzyme's catalytic activity. The best concentration of glutaraldehyde to produce the highest percentage of immobilized enzyme and the best activity is at 0.5% (v/v). Theimmobilizedlipasehas abetter stabilityinmultiple reuses.

Recommendation

In the future, in order for this research to develop further, researches on the influence of deacetylation degree of chitosan in the enzyme immobilization process, its thermal stability and its reuse stability need to be carried out so that a biocatalysts with both optimal activity and stability could be produced.

REFERENCES

Cahyaningrum, Narsito, Santoso, Agustini,2009, *Peranan JembatanKationLogamdalamimobilisasi Papain padaKitosan*, Disertasi S3Fakultas MIPA, UGM, Yogyakarta

Krajewska, B., 2004, Application of Chitin and Chitosan-Based Materials for Enzyme Immobilizations : a Review, *Enz. Microb.Technol*, 35, 126-139.

Schiffman, J. D., Schauer, G.L.,2007, Cross-linking Chitosan Nanofiber, *J.Biomas*, 8,5,94-101

Suhartono, M. T., 1989, *EnzimdanBioteknologi*, DepartemenPendidikandanKebudayaan, DirektoratJenderalPendidikanTinggi, PusatAntarUniversitasBioteknologi, InstitutPertanian Bogor, Bogor.

Xu, W.L., Fu, C.L., Li, L.I., 2001, Studies on the Adsorption Capacity for Bilirubin of the Adsorbent Chitosan-β-cyclodextrin, *Chinese Chemical Letters*, 12, 359-362

Zubriene, A., Budriene, S., Gorochovceva, N., Romaskevic, T., Matulionis, E., Dienys, G., 2003, Immobilization of hydrolases onto chitosan microparticles, Chemija, 4,14, 226- 230

BIOSORPTION OF CADMIUM (Cd) AT GREEN COCO FIBER

(*Cocos nucifera*) WAS ACTIVATED BY USING ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS) METHOD

Syamsidar HS[1)], Yuniati Udin[2)]
Departement of Chemistry Faculty of Science and Technology Alauddin State Islamic University Makassar
Jl. Sultan Alauddin No 36 Samata Gowa
E-mail : *syamsidar_hs@yahoo.com*

ABSTRACT

Various human activities are potentially produce heavy metal waste. The waste if it is not treated properly will cause environmental pollution and are toxic to organisms living including humans. Biosorbent has several advantages, including relatively low cost and easy to obtain.

The use coco fiber as biosorbent is one good use of waste to reduce environmental pollution. Has conducted research cadmium biosorption (Cd) on biosorbent green coconut coir fiber (*Cocos Nucifera*) activated NaOH. This study includes the determination of the optimum concentration for activation biosorbent base, determination of optimum pH, determining the optimum time and capacity biosorption by using atomic absorption spectrophotometer (AAS).

The results showed that the highest concentrations of NaOH activation biosorbent is 1.8 M or 11.2310 mg / L. The highest pH used by biosorbent activated is pH 2 or 19.6 mg / L, the highest timing needed to adsorb Cd is 30 minutes ie 14.7941 mg / L, whereas the highest biosorption capacity at a concentration of 70 ppm is 32.2882 mg / L

Keywords: G*reen coconut husk fiber, cadmium (Cd), biosorbent activated NaOH*

BACKGROUND

Activities of human life are very high it turns out has caused various adverse effects to human life and the environment layout. The result will be a shift in the balance in the governance of the environment to a new form that is likely to be worse. This is what causes environmental pollution, whether in water, soil and air. One of the most dangerous pollutants are heavy metals.

Heavy metals are chemicals that are very harmful when present in the human body. Heavy metals in water or waste with concentrations exceeding the threshold can adversely affect normal biological cycle in the environment in both humans and other living things. Among the metal ions harmful environmental pollutants and toxic namely Cadmium (Cd), Lead (Pb), zinc (Zn), Mercury (Hg), Copper (Cu), and iron (Fe). In this regard, the presence of heavy metals in the water and in the environment should be eliminated. Various methods have been developed to reduce the content of metals in the environment, especially metal cadmium (Cd). One method to do is adsorption. The use sorbent of organic material (biosorbent) lately very much developed. Biosorbent has the advantage to overcome dangerous and toxic metals in the environment because the price is relatively cheap, readily available, renewable and environmentally friendly nature. One is biosorbent derived from coconut fiber green.

Green coconut coir fiber is potentially as biosorbent because it contains a carboxyl group (-COOH) and lignin-containing acid phenolat who had a role in metal binding. cellulose and lignin is a biopolymer that is associated with the separation of heavy metals (Pino, et al, 2005).

Biosorbent with the ability to obtain higher biosorption activation needs to be done using alkaline (Massel, 1996). This activation aims to increase the specific surface area and active sites. Activation treatment using sodium hydroxide (NaOH) causes the impurities contained in green coconut fiber will dissolve so that the pores become more open which allows an increase in specific surface area. Based on the background and the paragraph above, the researchers are interested to study the green coconut fiber to its ability to absorb the metal cadmium (Cd) in contaminated water.

MATERIALS AND METHODS

a. Preparation biosorbent.

Fiber Green Coconut (*Cocos nucifera*) Objects that were analyzed, namely green coconut coir fiber, coconut peeled old has been prepared and the fiber is separated from the cork. Coconut fibers that have been separated washed clean and rinsed with aquabidest, then dried. The samples were cut into small pieces or blended and then sieved using (+ 40-100) mesh. Coconut fiber is then washed again with aquabidest until clean. The sample was then dried in an oven at 70°C, up to a constant weight is obtained and stored in eksikator

b. Activation biosorbent.

A total of 2 gram biosorbent put into 9 pieces erlenmeyer, then each added 25 mL of NaOH solution with varying concentrations of 0.2; 0.4; 0.6; 0.8; 1.0; 1.2; 1.4; 1.8 and 2.0 M then stirred for 2 hours, the results are filtered and the residue washed with aquabidest to pH neutral (pH 7). Biosorbent then dried in an oven at 70 ° C and stored in eksikator.To obtain optimum NaOH biosorbent activated, each of 0.5 grams of NaOH activated biosorbent put into 9 pieces erlenmeyer and added 25 mL of cadmium (Cd) 20 ppm, then dishaker for 2 hours. The resulting solution is filtered and the filtrate was analyzed by AAS at a wavelength of 228.8 nm.

c. Determination of Optimum pH biosorption.

A total of 0.5 grams of activated biosorbent put into 5 pieces of 250-ml Erlenmeyer, then added 25 mL of 20 ppm Cd, add a few more drops of HCl pa into each solution to obtain a predetermined pH is pH 1, 2, 3, 4 and 5. The mixture is then stirred with a shaker for 2 hours. Furthermore, the resulting solution is filtered and the filtrate is taken to be analyzed using atomic absorption spectrophotometer (AAS) at a wavelength of 228.8 nm.

d. Determination of Optimum Time biosorption

Into a 250 ml Erlenmeyer each put 0.5 grams biosorbent activated and added to each 25 mL of solution with a concentration of 20 ppm Cd with optimum pH obtained previously. The solution was stirred using a shaker with respectively 10, 20, 30, 40 and 50 minutes. Subsequently, the mixture was filtered and the filtrate is taken to be analyzed using atomic absorption spectrophotometer (AAS) at a wavelength of 228.8 nm.

e. Determination of Capacity biosorption

A total of 0.5 grams of activated biosorbent put in a 250 mL Erlenmeyer 5 pieces and added with 25 mL of Cd with varying concentrations of 30, 40, 50, 60 and 70 ppm, then interacting that during contact time and pH optimum. After the resulting solution is filtered and absorbance is measured with atomic absorption spectrophotometer (AAS) at a wavelength of 228.8 nm.

RESULTS AND DISCUSSION

A. Determination of Activated Concentration Variations Using Bases (NaOH)

Based on the results by varying the concentration of NaOH activation in a row that is 0.2; 0.4; 0.6; 0.8; 1.0; 1.2; 1.4; 1.8 and 2.0 M. The highest uptake was obtained in of the activation of a 1.8 M variation amount of 11.2310 mg / L. Activation smallest at 0.8 M of 7.2724 mg / L. Activation absorption chart can be seen in the graph below.

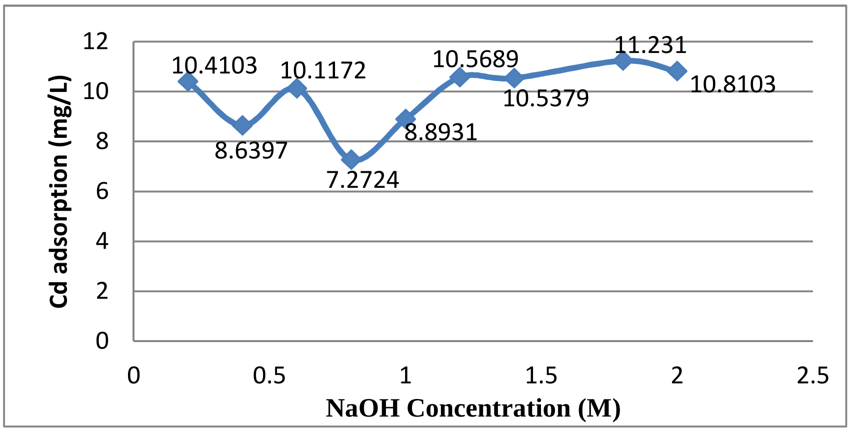


Figure 1. A graph of the variation of contact time biosorbent green coconut fiber on the adsorption capacity of Cd (mg / g).

On the graph 1 shows that the amount of Cd absorbed up and down is not stable due to higher concentrations of NaOH were added, to obtain the highest concentration of 1.8 M. The results obtained by the chart can not show the optimum point, where the results do not fit the theory that increasing the concentration of NaOH, the better process of formation in the active site.

This can occur because the active sites on the surface biosorbent NaOH, pore biosorbent and the active site of NaOH is not functioning properly so it can not absorb Cd perfectly. The use of alkaline activation lead to decreased absorption of ions. This is thought to occur because at the time the addition of NaOH there are some active site of coconut fiber such as lignin experiencing delignification reaction, where the lignin is degraded by NaOH. Lignin is expected to absorb the metals, but lignin did not participate in the process of absorption because it has been unraveled. In addition, the instability of the graph can also be caused because the sample had been contaminated by the air during storage after constant sample weight and possible sample has been contaminated with air so that the samples that had previously been a constant water level is now increased back to affect the weight of the sample.

This causes the active groups of fibers which carboxyl group is bonded to metals should be able to bind well with water so that the resulting reduction in the value of adsorption obtained. On the addition of a greater concentration of NaOH is 2.0 M started to decrease the amount of Cd absorbed. This may indicate that the concentration of NaOH began to decline in forming the active site so that the metal absorbs biosorbent less optimal.

B. Determination of Optimum pH by biosorbent (Fiber Coconut Green)

The determination of the optimum pH biosorbent activated coco fiber green made at a concentration of 20 ppm Cd solution. PH variation is 1, 2, 3, 4 and 5. According to the Appendix, then the average measurement results adsorption capacity of active biosorbent green coconut fiber to variations in pH. Graph Cd uptake by biosorbent green coconut fiber is activated at various pH variation can be seen in the graph below.

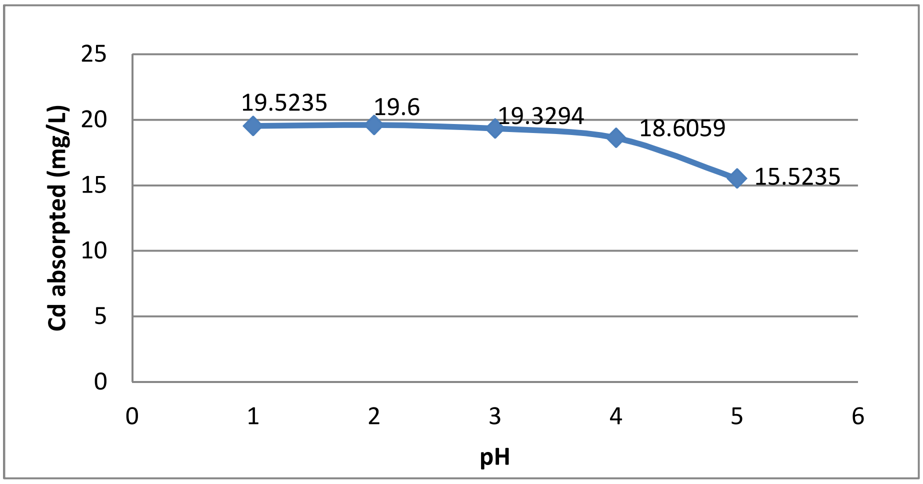


Figure 2. Graph The relationship between variations in pH by adsorption biosorbent green coconut coir fiber to Cd.

On the graph 2 shows that the highest absorption of Cd is at pH 2, with the value of the absorption efficiency is 19.6 mg / L. In the determination of the pH value is absorbed by a very small biosorbent ranged 0.1-0.2 mg / g. The results obtained have not shown significant changes to the absorption, so that the pH determination there is almost no considerable influence on the absorption of Cd.

This can occur due to the acidic pH, ions are subjected to forces repel each other, as presented by Sembiring (2009), at low pH uptake of all low metal ion. This is because on the surface of the adsorbent surrounded by H^+ ions. In acidic conditions also positively charged adsorbent surface, thus causing a repulsion between the adsorbent surface with metal ions, so that the adsorption becomes low.

According to Refilda, et al (2001), at alkaline pH metal ions can form a hydroxide precipitate thus hard to determine absorption efficiency. It can be concluded that the acid and alkaline pH range Cd uptake by coco fiber is less effective. This is why the process is not optimal absorption Based on the theory, in general, increased adsorption in the pH range in which an electrically neutral organic compounds that will bind to ion interaction can occur with either. As the result of research conducted by Ratna Dewi (2012), using straw as biosorbent in the allowance Cd in water to obtain a pH optimum is at pH 7. It can be concluded that in the pH range of acids and bases by the adsorption process of green coconut fiber is less effective.

C. Determination of the optimum time by biosorbent (Green coconut fiber)

The determination of the optimum time biosorbent green coconut fiber is activated to Cd is done by varying the contact time which starts from 10, 20, 30, 40 and 50 minutes with concentrations of Cd metal used is 20 ppm. Measurement of the variation of contact time with the Cd solution using atomic absorption spectrophotometry.

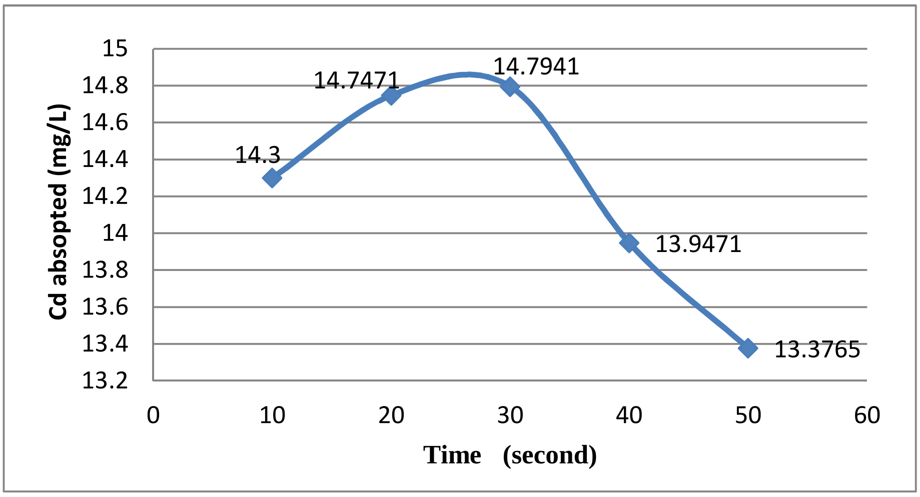


Figure.3. A graph of the variation of contact time biosorbent green coconut fiber on the adsorption capacity of Cd (mg / g).

Based on the graph, the optimum absorption at 30 minutes with the absorption efficiency of 14.7471 mg / L. At the beginning interaction time from 10 minutes to 20 minutes of the adsorbed metal continues to increase until peaking at 30 minutes, but after 40-50 minutes absorbed Cd metal number has decreased. This situation is consistent with the theory that the adsorption process will stop if there has been a balance in which the adsorbate concentration in the solution and the adsorbent material remains. In this case the active carboxyl groups have experienced equilibrium, so the solution is saturated and no longer able to absorb metal optimally. Time obtained in this study is slightly slower than the research done by Anasthasia, et al (2014), using the dragon fruit skin to absorb the metals Cd in the solution to obtain optimum contact time results faster in the 20th minute.

Similarly, the theory put forward by Sukardjo (1990) that if a solution of two or more substances, substances that one will be absorbed more strongly than other substances. The amount of substance that is absorbed per weight of adsorbent depends on the concentration of solute nevertheless adsorbennya already saturated when the concentration is no longer influential.

D. Determination of Adsorption capacity by biosorbent (G*reen coconut fiber*)

The determination of the optimum time biosorbent green coconut fiber is activated done by varying the concentration of Cd 30, 40, 50, 60 and 70 ppm. Cd Measurement data can be seen in the following chart.

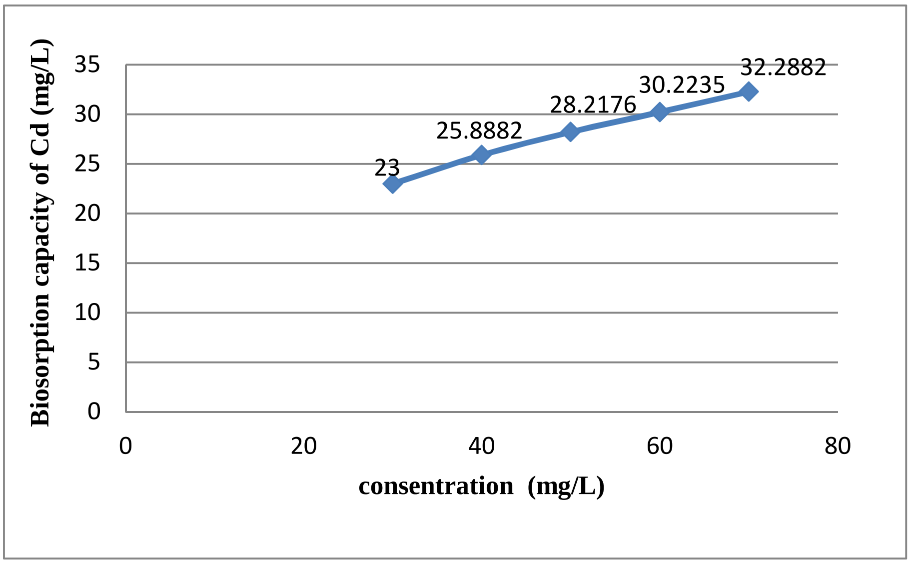


Figure 4. Graph of variations concentration (mg/L) and biosorption capacity (mg/L) /

Based on the graph it can be seen that the results of Cd uptake increased with increasing concentrations of the metal. The highest uptake was obtained at a concentration of 70 ppm is 32.2882 mg / L. While the lowest absorption is obtained at the lowest concentration of 30 ppm at 23 mg / L. Increasing metal ion concentration of Cd in the absorption process, it also increase the adsorption occurs in coconut fiber. the graph of the results obtained have not shown the optimum point but the highest point of absorption, because in this situation has not occurred saturation in which the groups active on the cellulose still able to absorb Cd metal with a higher concentration of Cd. So as Cd metal can still be bound by the cellulose in coconut fiber.It can be seen from the value of accuracy obtained, based on the calculation results R value 0.995. These results indicate that the higher the R value, the error rate is getting smaller. The following is a reaction mechanism that occurs between the groups contained in the cellulose and the metals Cd.

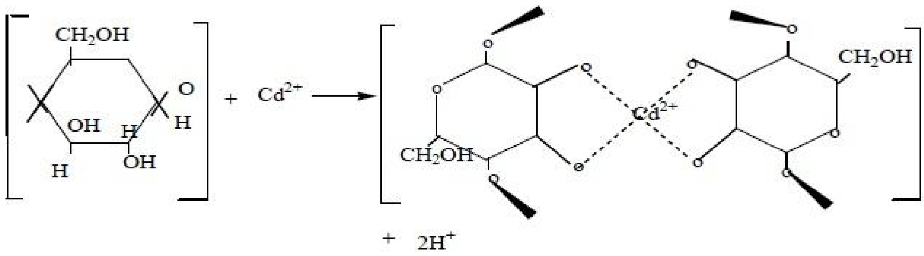


Figure 5. Graph of cellulose and Cd chelation

Uptake mechanism that occurs between -OH group attached to the surface, with a positively charged metal ion is an ion exchange mechanism. The interaction between -OH with metal ions is also possible through the formation mechanism of coordination complex, because the oxygen atom in the -OH group has a lone pair. The bond between Cd^{2+} ions with -OH on cellulose through coordination bond formation, where the lone pair of O in OH would bind to metal ions Cd^{2+} form complexes through covalent bonds.

CONCLUSION

Based on the purpose of research it can be concluded that:

1. Activation highest green coconut fiber (*Cocos nucifera*) to adsorb metals cd is the activation of a 1.8 M with absorption values 11.2310 mg/ L
2. The highest pH of green coconut fiber (*Cocos nucifera*) to adsorb metals Cd is at pH 2 with absorption value of 19.6 mg / L
3. The contact time highest of green coconut fiber (*Cocos nucifera*) to adsorb metals Cd is 30 minutes with the absorption value of 14.7941 mg / L.
4. The capacity biosorption obtained of green coconut fiber (*Cocos nucifera*) to the highest Cd metal concentration is at a concentration of 70 ppm with a capacity value of 32.2882 mg / L and the lowest absorption occurred at a concentration of 30 ppm with a capacity value of 23 mg / L.

REFERENCES

Achmad, Rukaesih. *Kimia Lingkungan*. Yogyakarta: ANDI, 2004.

Agustina, Dewi. *Kadar Lignin dan Tipe Monomer Penyusun Lignin pada kayu Akasia*. Skripsi Fakultas Kehutanan. Bogor: Institut Pertanian Bogor, 2009.

Dananto, Y C. dan Samun T. *Pengaruh Aktivasi Karbon Dari Sekam Padi Pada Proses Adsorpsi Logam Cr (VI).* EKUILIBRUM. Vol. 7. No. 1. (Januari 2008): h. 13-16. Fakultas Teknik. Surakarta, 2008.

Departemen Agama Republik Indonesia. *Al-Quran dan Terjemahannya.* Bandung: Diponegoro, 2008.

E. Himmel, Michael *et al. Biomass Recalcitrance: Engineering Plants and Enzymes for Biofuels Production*. Jurnal Internasional, Vol. 315. SCIENCE, 2007.

Hendayana, Rafilda, dkk. Materi Pokok kimia Analitik Instrumen. Universitas Terbuka: Jakarta, 2001.

H. Sugiyarto, Kristian. *Kimia Anorganik II* . Universitas Negeri Yogyakarta: JICA, 2003.

Khalifah, Susi Nurul. *Studi Keseimbangan Adsorpsi Merkuri (II) Pada Biomassa Daun Enceng Gondok (Eichhornia crassipes) yang Diimobilisasi Pada Matriks Polisilikat*. Skripsi Fakultas Sains dan Tekhnologi. Malang: UIN Malang, 2007.

Khopkar, S.M. *Konsep Dasar Kimia Analitik*. Jakarta: UI-Press, 2007.

Krismastuti, dkk, *Adsorpsi Ion Logam Cadmium Dengan Silika Modifikasi.* Laporan Hasil Penelitian Pusat Penelitian Lembaga Ilmu Pengetahuan Indonesia. Tangerang, 2008.

Kusnandar, Feri. *Kimia Pangan*. Jakarta: Dian Rakyat, 2010.

Menteri Kesehatan Republik Indonesia. *Peraturan Menteri Kesehatan Republik Indonesia Nomor 492/MENKES/PER/IV/2010 Tentang Persyaratan Kualitas Air Minum*. (2010). http://www.litbang.depkes.go.id/sites/download/regulasi/permenkes/Permenkes_492-th-2010.pdf, (18 Oktober 2013).

Messel, R.I. Principless of Adsorption and reaction on Solid Surfaces. First Edition, John Willey and Sone. Illionis

Nurahma, Andi. *Analisis kandungan zat Besi (Fe) pada Daun Dan Buah kelor Yang ada di Desa Mattajang Kecamatan Dua Boccoe kabupaten Bone*. Skripsi. Makassar: UIN Alauddin, 2010.

Okafor, P.C *et. al*. *Adsorption Capacity of Coconut (Cocos nucifera L.) Shell for Lead, Copper, Cadmium and Arsenic from Aqueous Solutions*. Department of Chemistry, School of Mathematical and Physical Sciences, North-West University, Int. J. Electrochem. Sci, 7, 2012.

Palar, Heryando. *Pencemaran dan Toksisitas Logam Berat.* Jakarta: Rineka Cipta, 2004.

Pertiwi, Dini dan Welly Herumurti. *Studi pemanfaatan Sabut Kelapa Sebagai Karbon Aktif Untuk Menurunkan Konsentrasi Fenol*. Institut Teknologi Sepuluh Nopember, Surabaya, 2009.

Pino, G.H, *et. al. Biosorption of Cadmium by Green Coconut Shell Powder*. Metallurgi and Material, 225-Gavea. Rio de Janeiro-RJ, Brazil, 2005.

Rahmayanti, Prima Vinka. "Optimasi pH dan Waktu Kontak Biosorpsi Zat Warna *Remazol Yellow* Oleh Biomassa *Rhyzopus Oryzae* Aktif Dan Terimobilisasi". *Skripsi* (Jurusan Kimia FMIPA) Surakarta: Universitas Sebelas Maret, 2007.

S. Arbintarso, Ellyawan. *Tinjauan Kekuatan Lengkung Papan Serat Sabut Kelapa Sebagai Bahan Teknik*. Jurnal Teknologi, Vol. 2, no. 1(Juni 2009): h. 53-60. Institut Sains & Teknologi Akprind Yogyakarta. Yogyakarta, 2009

Samin, Supriyanto C dan Zainul Kamal. "*Analisis Cemaran Logam Berat Pb, Cu dan Cd pada Ikan Air Tawar Dengan Metode Spektrometri Nyala Serapan Atom (SSA)*". (Seminar Nasional III, Pusat Teknologi Akselerator dan Proses Bahan) Yogyakarta: SDM Teknologi Nuklir, 2007.

Sembiring, Rosdiana. *Adsorpsi Logam Cr (VI) oleh Biomassa Chara Fragilis Menggunakan SSA*. Universitas Sebelas Maret, Surakarta, 2009.

Sudiarta, I Wayan dan Dwi Ariani Yulihastuti. *Biosorbsi Kromium (VI) pada serat Sabut Kelapa Hijau (Cocos nucifera).* Jurnal Kimia 4 (2), (2010): h. 158-166. FMIPA, Universitas Uadayana, Bali, 2010.

.........., I Wayan dan Emmy Sahara. *Biosorpsi Cr (III) Pada Biosorben Serat Sabut Kelapa Teraktivasi Natrium Hidroksida (NaOH)*. Jurnal Kimia 5 (2). 2011: h. 133-142.FMIPA, Universitas Uadayana, Bali, 2011.

.........., I Wayan dan Wahyu Dwijani Sulihingtyas. *Biosorpsi Cr(III) Pada Biosorben Serat Sabut Kelapa HijauTeramobilaisasi EDTA.* Jurnal Kimia 6 (1), 2012: h. 29-36. FMIPA, Universitas Uadayana, Bali, 2012.

Sukardjo. *Kimia Fisika*. Cet. 3; Jakarta : PT. Rineke Cipta, 1990.

Tyas, Sekar Insani Sumarning. *Studi Netralisasi Limbah Serbuk sabut Kelapa (cocopeat) Sebagai Media Tanam*. Skripsi Sarjana, Institut Pertanian Bogor, Bogor, 2000.

Wahyudi. *Pengaruh Varietas dan Umur Kelapa (Cocos nucifera) Terhadap Tebal, Berat, dan Kadar Serat Nata De Coco*. Skripsi. Jurusan Biologi Fakultas MIPA. Malang: Universitas Negri Malang, 2009.

World Health Organization (WHO). *WHO Human Health Risk Assessment Toolkit: Chemical Hazards*. http://www.who.int/ipcs/publications/methods/harmonization/toolkit.pdf, (18 Oktober 2013).

Widihati, I. A. G, dkk. *Karakterisasi Keasaman dan Luas Permukaan Tempurung Kelapa Hijau (Cocos nucifera) dan Pemanfaatannya sebagai Biosorben Ion Cd^{2+}*. Jurnal Kimia 4 (1). FMIPA, Universitas Udayana, Bali, 2010.

Widowati, Wahyu, dkk. *Efek Toksik Logam*. Yogyakarta: ANDI, 2008.

Zulfikar. *polisakarida*. (20 November 2010), http://www.chem-is-try.org/materi_kimia/kimia-kesehatan/biomolekul/polisakarida/, (19 oktober 2013)

The Effect of Voltage on The Metal Concentration (Hg, Pb, and Zn), Conductivity and Color on The Electrocoagulation - Flotation Process in a Waste Incinerator Liquid.

Merry Anggriani[1], Bohari Yusuf[2] and Rahmat Gunawan[2]
[1]Research Laboratory, Department of Chemistry, Faculty of Mathematics and Natural Sciences, Mulawarman University
[2]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Mulawarman University
*Corresponding Author: bo_bohari@yahoo.com

ABSTRACT

Have done research about the effect of voltage on the metal concentration (Hg, Pb and Zn), conductivity and color on the electro-coagulation - flotation process in a waste incinerator liquid. The analysis showed that the pH parameters for water Scrubber and Quencher generate percent allowance of up to 20.6119% and 12.0773%, while the parameters of electrical conductivity (EC) for Water Scrubber and Quencher generate percent allowance of up to 12.0782%, and 10, 4213%. Metal parameter Hg for water Scrubber and Quencher generate percent allowance of up to 57.2727% and 77.1144%, then the parameters of metals Pb for water Quencher and Scrubber generate percent allowance of up to 81.0769% and 49.7835%. Metal Zn parameters for water Scrubber and Quencher generate percent allowance of up to 76.6679% and 49.0246% and the color parameters for water Scrubber and Quencher generate percent allowance of up to 46.1538% and 77.5194%.

Keywords: electro-coagulation, flotation, voltage, quencher, scrubber

Introduction

Water is one element that is very important for the environment. The environment can be said to be good if the elements that composed the environment is maintained. The occurrence of water pollution as a result of a diverse community activities as well as industrial activities would be bad for the environment. This water pollution can occur due to discharge liquid waste generated by industries or factories that are not maintained properly and dumped into waterways or the surrounding ground surface.

One of the causes of pollution is the amount of wastewater discharged without prior treatment or have been processed but not yet meet the requirements. This is possible because of the reluctance treat wastewater, in addition to the unavailability of a wastewater treatment technology that is easy and efficient so that it can be applied in an industry.

Some wastewater treatment technologies that have been applied generally still about coagulation-flocculation through the addition of chemicals, sedimentation, neutralization, activated sludge and anaerobic. This technology is commonly used in all types of industrial wastes that are less effective when applied to a metal-based industries with the specific content of the waste. Technically waste with specific characteristics is containing oil and dissolved heavy metals is high enough such technology is less efficient. This is indicated by the coagulant-flocculant material needs are many and the volume of solid waste generated large, thereby increasing the cost of processing and handling of solid waste.

A method that is more efficient and cheaper to treat wastewater with varied types of pollutants and minimize the additive is needed in the management of water sustainability. Electrocoagulation is a processing method that is able to address these problems by Peter in 2006.

Electrocoagulation is the process of coagulation and precipitation of fine particles in water using electric energy. Electrocoagulation process is performed on the electrolysis vessel in which there are two direct current conductors called electrodes are immersed in an electrolyte solution as a waste.

Heavy metals are often found in water pollution is Hg, Pb, Cd, Cr, Cu, Ni, and Zn in the form of toxic compounds (Conne, D W. 1974). One of the heavy metals that become the focus of discussion is lead and zinc. Based on these problems need to be an attempt to reduce pollutant parameters with Electrochemical processing. This study tried to exploit Electrocoagulation method. In addition this study is testing metals Hg, Pb and Zn, electrical conductivity (EC) and color by determining the percent allowance metal concentrations of Hg, Pb and Zn in the samples after the electrocoagulation and electroflotation, comparisons strong currents, the influence of pH, electrical conductivity (EC), a decrease of colour, and the deposition of the electrocoagulation process results and electroflotation and comparing the levels of Hg, Pb and Zn with the quality standards set by the government

Materials and Method

The tools used in this research is the electrode cylinder Titanium, cable jack crocodile, water hoses, glass beaker, adapters, pipette, measuring cup, pipette volume, bulp, pumpkin erlenmeyer, funnel glass, stopwatch, glass mettler, sample bottles, bucket, dericain (drigen), atomic absorption spectrophotometer (AAS), measuring instruments pH (mettler toledo), konduktimeter, UV spectrophotometer hach, NIC Mercury Analyzer SP-3D, furnace, flask, cuvette, boat, saucer porcelain, micro pipette, boat tongs, spatula. While the materials used in this study were sampled Quencher and Scrubber, distilled water, aquabidest, Pb and Zn standard solution, tissue, paper labels, acetylene gas.

Research procedure

Sampling Techniques

The sample used for the study were taken from Incinerator Liquid, to determine the quality of wastewater is conducted test sampling in the area Quencher and scrubber as much as ± 5 L.

Electrocoagulation Process

Prepared adapter, and then connect the adapter to the connecting cable, then the electrode cylinder that has been cleaned is positioned in a suite of tools that partially submerged the next second electrode is then connected to the adapter.

The Effect of Voltage

Electrocoagulation assembled tool, as much as ± 5L samples of waste put into dericain on a suite of tools, a powerful set flow adapter on the current 0.5 a, then ignited a strong variation of the voltage with the voltage of 4.5; 9 and 12 volts, and determined the optimum conditions of these parameters based on the large percentage of reduction in pollutant levels.

Analysis of Conductivity

The tool is turned on and calibrated prior to measurement, approximately 10 ml samples were taken and put into a glass beaker. Conductimeter electrode is inserted into the solution so that conductimeter will automatically read the conductivity of the sample as well as the temperature of the solution. Electrodes are washed using aquabidest each will start a new measurement of the sample. The analysis was performed for each sample.

Analysis of pH

The tool is turned on and calibrated prior to measurement, rinse the electrode with distilled water and then dried with a tissue, put into a glass electrode mettler containing blank then distirer slowly. Electrodes are inserted into the sample solution to be analyzed for 1 minute so that it will automatically read the pH of the sample. Electrodes are washed using aquabidest each sample and the measurement will start after all the samples was measured.

Color Analysis

HACH DR 2800 UV spectrophotometer is turned on, then wait a moment approximately 10-15 minutes in advance so that the tool can be used. Click and select the program Favorite color 125 and 455 nm then START new screen will appear. Aquabidest blank solution is already existing in the cuvette is inserted in the cell holder and then covered later ZERO is pressed on the screen. Each of these water samples and water scrubber Quencher scratch, water and water Quencher scrubber results electrocoagulation 4.5 V, 9 V and 12 V that already exist in the cuvette is inserted in the cell holder and closed alternately and then press the READ on the screen and it will appear results analysis on the screen in units PtCo.

Analysis of Metal Pb and Zn by using Atomic Absorption Spectrophotometer

The tool is turned on, then wait a moment approximately 10-15 minutes in advance so that the tool can be used. Opened worksheet then be optimized lights, after the lights come optimization then the instrument will read the absorbance of the blank and standards, then projected on the calibration curve to obtain the levels / concentrations of metal blanks and standards are used. Once it is done reading the absorbance of the sample.

No	Voltage	Flow (A)	Time (Min)
1	4,5	0,5	30 min
2	9	0,5	
3	12	0,5	

Samples can be measured properly if its concentration is in the calibration curve. Do flushing hose / tubing with aquabidest taste every time displacement measurement sample or standard, it aims to reduce the contamination of the solution.

Analysis of Mercury by using NIC Mercury Analyzer SP-3D

Turned on the MD-1, MA-1 and Computers, then placed additive M and B in a porcelain cup each, then put the additive and 3 pieces of sample boat into the furnace at a temperature of 750°C for 1 hour. Used modes: 2 on the instrument instrument. At the start of instruments NIC in a state without sample boat (the result obtained must be less than 0.05 ng), then put an empty boat as a blank sample (the result obtained must be less than 0.05 ng), M additives included in the sample boat, put the total sample of 10 mL, closed sample with additive M and additives B, then put the sample boat into the combustion tube, press Start, then repeated for the next sample

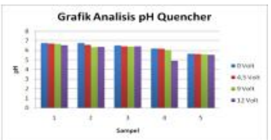
Technique of Analysis Data

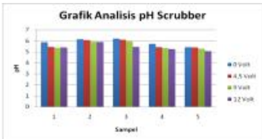
In this study, data analysis performed using ANOVA test was used to compare the average of two variables in one group. Hypothesis testing method is useful for the testing two samples related or two paired samples.

Result and Discussion

This research used cylindrical electrodes with a titanium base material, in addition to being easy to obtain, the electrode used is an electrode that is no longer used in the plant. Scientists in terms of titanium are inert electrodes where the metal contained in the electrode does not participate, react during electrocoagulation process is underway, resistant to corrosion and has a low specific weight. The titanium cylinder electrodes act both as cathode and anod.

Theoretically, the larger the voltage is used, the greater the air bubbles generated through electrolysis process that causes the dirt (flocs) were formed, namely the oxidation of particulate contaminants and impurities will be lifted to the surface. Floc had formed began to swell and undergo flotation and sedimentation resulting in metal concentrations in samples Scrubber Quencher and declining. The decline resulted in increasing the percentage of efficiency decline that occurred in each treatment with continuous system (flow). Reactions that occur in this process is largely a reduction-oxidation reaction between water with impurities present in solution.

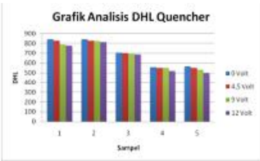


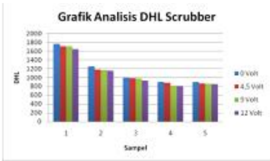


In the analysis of pH does not change significantly, and there is a tendency to stagnate in the use of cylindrical electrodes. According to Bambang, 2010, this is possible because Ti ions can cause alkaline conditions in the waste. So it can be predicted that for the liquid waste processing acid using electrocoagulation can effectively raise the pH to the pH range permitted by government regulations. Thus, the shape of the contaminants will be deposited and can be easily removed by separation. Deposition process occurs as the process of coagulation, the coagulant is formed on the electrode reactive, triggered by electric current.

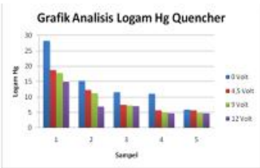
Voltage (potential difference) is proportional to the magnitude of electric current flowing in the electrode. Electric current causes electro transfer from the electrode to the electrolyte solution. The existence of this electric current causes chemical reactions in solution. The greater the applied voltage, the greater the flow of electrons to the electrode so that the faster chemical reactions in solution, namely the increasing number of bubbles (gas) is formed. The greater the voltage applied to the more flocs generated which can bind contaminants in the sample. However, at each variation of the mains voltage magnitude of the percentage reduction in parameters measured efficiency can be increased at a certain time.

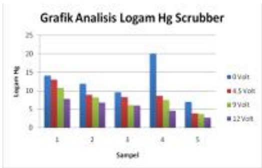
The presence of a layer attached to the electrode and privacy occurred at the anode can prevent electric current to flow into the solution, as the titanium ions produced at the anode is not as big as the previous voltage (Harmani, 2014).

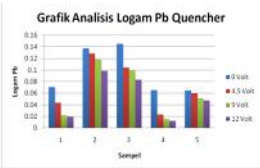


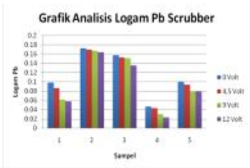


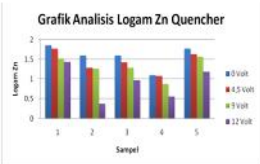
Electrical conductivity relates to the ability of a sample to conduct electricity because of the dissolved solids in the sample solution. Changes in the value of conductivity on samples Scrubber and Quencher electrocoagulation-flotasion results is not significant to happen. shows the current is moving in the solution can not move freely so that interactions between molecules in the sample solution showed no significant value.

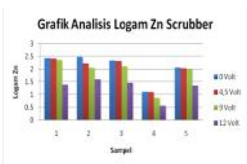












Due to the increased formation (Metal + OH-) at the time the longer run or current used increasingly enhanced. In this case (Metal + OH-) is a coagulant compound that acts as a coagulant and absorbent material of various organic and inorganic pollutants contained in the wastewater, thus forming complex compounds with a molecular weight greater and easier sedimented. With more and more precipitate formed causing a decrease in the amount of pollutants in water, so the longer the water seems increasingly clear/turbidity levels wane (Sutanto, 2011).

If in an electrolyte solution are placed two electrodes and electrified in the same direction, there will be events electrochemical (symptoms of decomposition-electrolyte) that positive ions (cations) move to the cathode and receives electrons is reduced and negative ions (anions) move to the anode and submit electron oxidized, thus forming a floc that is able to bind contaminants and particles in the waste.

Gas bubbles generated at the electrocoagulation process causes the impurities that are formed will be lifted to the surface. Impurities formed is called floc because of its relatively small size. The more dirt that lifted up the size will increase. Then do the deposition process after experiencing electrocoagulation water. The deposition process is used to precipitate the flocs formed. In the cylindrical electrodes will cause cations irrespective then interact freely with industrial wastewater samples. Next will happen hydrolysis to form a complex hydro-titianium (precipitation). This hydrolysis process is dependent on the total concentration of the metals Pb, Zn and mercury, and the pH of the wastewater.

Susetyaningsih, et al (2008) stated that the electrochemical process (electrolysis) will be minimum in case of saturation of the cylindrical electrode and the magnetic field would also be very small lead levels (metals) in the waste being fixed. If it takes place continuously, the levels (metals) in the waste will not be reduced again. This is called electrocoagulation process reached its lowest point (do not give rise to a magnetic field). Electrocoagulation process flow system is influenced by the flow rate means the longer the reaction time so that more ions react. Where the experiments showed that the flow rate of 4ml / min.

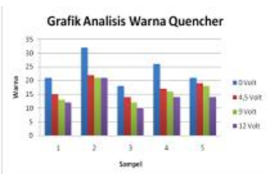
According to Dewi Masita, 2008, which says that the performance plate is one of the factors supporting the success of the removal efficiency. It can be said that the performance has been experiencing burnout plate. One of the causes of the above result is the formation of OH^- on the cathode is also getting reduced because of the attachment of deposition on the cathode. The greater the sediment menenpel, the larger the cathode surface covered and inhibition of the formation of OH^-. If OH^- generated yag reduced, meaning the binding of Fe^{2+} to form a coagulant will be reduced. So that the allowance that occurs in the reactor will be decreased which leads to increased concentration.

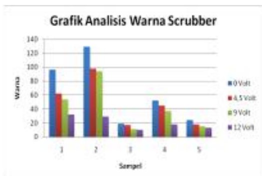
Marwati et al (2009) also adds in general there is no uniform trend between the amount of decrease in the concentration of metal ions with a potential difference being used. This occurs because the operational process of electrolysis is usually specific to a particular coating materials and require precise composition for the deposition of certain metals

From the data obtained is then compared with the value of quality standards set by the government refers to the East Kalimantan Regional Regulation No. 2 of 2011 on Water Quality Management and Water Pollution Control for Wastewater Quality Standard For the Business Activity of Specially Designated yet

No	Metals	The Value of Quality Standards (Regulations East Kalimantan Regional Regulation No. 2 of 2011)
1	Hg	0,002-0,005 mg/L
2	Pb	0,1-1 mg/L
3	Zn	5-10 mg/L

Judging from the East Kalimantan Regional Regulation No. 2 of 2011 on Water Quality Management and Water Pollution Control for Wastewater Quality Standard For Business Activities are yet adopted by Specifically, the concentration of metal ions Pb and Zn does not exceed the quality standards. As for the concentration of metal ions mercury exceeds the quality standards set by the government. So, we need further processing before being discharged/supplied to the free waters.





Theoretically, the higher the voltage, the more contaminants are bound to a substance that causes a color in a sample will be reduced. So it can be said electrocoagulation-flotation process on samples Scrubber and Quencher capable of making samples before cloudy becoming clearer.

Flocs formed in the electrolysis reaction will undergo flotation and sedimentation cause color density decreases. The color changes after electrocoagulation process. Samples were previously colored turbid, after electrocoagulation process becomes translucent color. In the murky color sample shows there are heavy metals and organic substances in waste water because these compounds cannot be precipitated because of its positive equal to the colloid of waste water (elfridawati, et al., 2013).

The actual color (true color) is usually caused by the presence of dissolved organic matter and colloids (Degremont, 1978). Before the color measurement is actually performed removal of suspended solids by filtration (Sawyer et al., 1978).

Based on the analysis using ANOVA test, obtained P-value> α, then Ho is accepted. So that the analysis of statistical test for analysis of pH, electrical conductivity (EC), Pb in the samples Scrubber and Quencher concluded there was no significant difference between the data prior to the data after electrocoagulation-flotation process. While the statistical test for the analysis of the samples Scrubber mercury Metal, Metal Zn on samples Scrubber and color analysis on samples obtained Scrubber P-value <α, then Ho is rejected. It concluded that there are significant differences between the data prior to the data after electrocoagulation-flotation process.

Conclusions

The effect of the variation strong voltage to decrease concentrations of Hg, Pb and Zn, conductivity and color in the process of electrocoagulation-flotation ie the greater the applied voltage, the greater the flow of electrons to the electrode so that the faster chemical reactions in solution, namely the increasing number of bubbles (gas) were formed. The greater the voltage applied to the more flocs generated which can bind contaminants in the sample. PH parameters to samples Scrubber and Quencher generate percent allowance of up to 20.6119% and 12.0773%, while the parameters of electrical conductivity (EC) for samples Scrubber and Quencher and generate percent allowance of up to 12.0782% and 10.4213%. Metal parameter Hg for the samples Scrubber and Quencher generate percent allowance of up to 57.2727% and 77.1144%, then the parameters Metals Pb for samples Scrubber and Quencher generate percent allowance of up to 81.0769% and 49.7835%. Parameter Metal Zn for samples Scrubber and Quencher generate percent allowance of up to 76.6679% and 49.0246% and the color parameters for samples Scrubber and Quencher generate percent allowance of up to 46.1538% and 77.5194%.

Suggestion

Expected in subsequent studies, the addition of coagulant such as alum (alum), ferisulfat, poly aluminium chloride (PAC = Poly Aluminium Chloride). Where with the addition of coagulant is the size of small particles that are difficult to settle will stick to the flock coagulant and then will settle. It is also for pH adjustment can be done by adding soda or lime.

References

Day, R. A. Underwood. 1980. *Analisa Kimia Kuantitatif*. Jakarta: Erlangga.

Bambang, I., Mawar D. S. S., dan Utari A. 2010. *Design Pengolahan Air Limbah Domestik Dengan Proses Elektrokoagulasi dengan Menggunakan Elektroda Aluminium".* Jurnal Teknologi Lingkungan Universitas Trisakti.

Benefield, L. D, Judkins J. F. and Weand, B. L. 1982. *Process Chemistry for Water and Wastewater Treatment*. Prentice Hall Inc.

Chamid, Chusharini. 2010. *Kajian Tingkat Konsentrasi Merkuri (Hg) Pada Rambut Masyarakat Kota Bandung dalam Prosiding SNaPP2010 Edisi Eksakta*. Bandung: UNISBA. pp. 113-114.

Elfridawati, Ali Kusrijadi, Yayan Sunarya. 2013. *Penggunaan Metode Elektrokoagulasi Pada Pengolahan Limbah Industri Penyamakan Kulit Menggunakan Aluminium sebagai Sacrificial Electrode*. Bandung: Program Studi Kimia Jurusan Pendidikan Kimia FMIPA Universitas Pendidikan Indonesia. Volume 4 No. 2 Hal 96-107.

Fraco, N. B. 1974. *Electrochemical Removal of Heavy Metal from Acid Mine Drainage*. Enviromental Protection Agency Report EPA-670 12-74-023.

Harmami, Ita Ulfin, Rike seryowuryani. 2014. *Penurunan Kadar Kromium Dari Limbah Cair Industri Penyamakan Kulit Dengan Metode Elektrokoagulasi*. Surabaya: Jurusan Kimia FMIPA Universitas Negeri Surabaya.ISBN: 978-602-0951-00-3.

Hasan, M. Iqbal. 2001. *Pokok – Pokok Materi Statistik 2 Jilid 2*. Jakarta: Bhumi Aksara.

Holt, P. K., Barton, G. W., Wark, M., and Mitchell, C. A. (2002). *A Quantitative Comparison Between Chemical Dosing and Electrocoagulation*. *Colloids and Surfaces A: Physicochem. Eng. Aspects*, 211:233-248.

Irving , F. and Curaham, J. , 1975. *Ammoniate Mercury Toxicity in Cattle, Can, Vet*, Vol. 16, 260-264.

LAPI ITB, Tim. 2002. *Audit Kegiatan Merkuri (Hg) Kegiatan Kilang LNG LPG PT Badak*. Bontang: PT Badak NGL.

Keputusan Menteri Lingkungan Hidup Nomor 51 tahun 2004 lampiran 2 tentang Baku Mutu Air Laut untuk Biota Laut.

Mukimin, Aris. 2006. *Pengolahan Limbah Industri Berbasis Logam dengan Teknologi Elektrokoagulasi flotasi*. Semarang: Program Magister Ilmu Lingkungan Pasca Sarjana Universitas Diponegoro.

Musmuliadi. 2015. *Efektivitas Metode Elektrokoagulasi Secara Batch Pada Penurunan Kadar Logam Cu*. Samarinda: Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Mulawarman.

Palar, Heryanto. 2004. *Pencemaran dan Toksikologi Logam Berat*. Jakarta: Rineka Cipta.

Peraturan Menteri Negara Lingkungan Hidup Nomor 03 Tahun 2010 Tentang Baku Mutu

Air Limbah Bagi Kawasan Industri.

Peraturan Daerah Provinsi Kalimantan Timur Nomor 02 Tahun 2011 Tentang Pengolahan Kualitas Air dan Pengendalian Pencemaran Air.

Peter, H. Geoffrey, B and Mitchell, C. 2006. *Electrocoagulation As a Wastewater Treatment, Departement of Chemical Engeneering*. The University of Sydney. New South Wales.

Purbaningsih, G. 2008. *Pengolahan Lindi TPA Benowo dengan Proses Elektrokoagulasi dengan Variasi Jarak Antar Elektroda dan Kuat Arus*. Tugas Akhir Jurusan Teknik Lingkungan FTSPITS.

Purwanto, S. H. 2005. *Teknologi Industri Elektroplating.* Semarang: Badan Penerbit Universitas Diponegoro.

Sudjana. 1996. *Metode Statistika*. Bandung : Penerbit Tarsito.

Suharjo, Bambang. 2008. *Analisis Regresi Terapan dengan SPSS*. Yogyakarta: Graha Ilmu.

Suma' mur. 2009. *Higiene Perusahaan dan Kesehatan Kerja (Hiperkes)*. Jakarta: Sagung Seto.

Susetyaningsih, R. 2008. *Kajian Proses Elektrokoagulasi Untuk Pengolahan Limbah Cair*. Seminar Nasional IV SDM Teknologi Nuklir.

Sutanto, D.S.T.S. Basuki, D. Wijayanto, 2007. *Model Alat Pendeteksi Ion Logam dalam Air dengan Metode Elektrolisis*. Laporan Penelitian, Jurusan Teknik Elektro, Politeknik Negeri Jakarta.

Trapsilasiwi, K. R. 2010. *Aplikasi Elektrokoagulasi Menggunakan Pasangan Elektroda Alumuium Untuk Pengolahan Air Dengan Sistem Kontinyu*. Jurnal Teknik Lingkungan ITS.

Woytowich D.L, Dalrymple C. W, Britton M. G.1993. *Electrocoagulation (CURE) Treatment of Ship Bilgewater for the U. S. Cost Guard in Alaska*.Marine Tech0ogy Society Journal, Vol. 27. 1p. 62, Spring 1993.

THE DIFFERENCE OF COGNITIVE LEARNING OUTCOMES BETWEEN STUDENTS WHO LEARNED BY USING PROBLEM SOLVING AND PROBLEM POSING LEARNING MODEL IN SALT HYDROLYSIS MATERIAL

Dian Eka Wati, Arif Sholahuddin

Chemistry Education of Institute Teacher Training and Education

Lambung Mangkurat University Banjarmasin, dian.eka_wati@yahoo.co.id

Abstract

This study aims to determine the differences of conceptual understanding, problem-solving skills, and to know the students' response to implementation of problem posing and problem solving learning model in salt hydrolysis material. This quasi-experimental research used pre-test-post-test comparison group design were took place at class XI student of SMAN 6 Banjarmasin. By using t-test analysis, this research showed that there are differences in conceptual understanding and problem solving skills significantly between students learned by using problem posing and problem solving learning model. The students's cognitive learning outcomes who learned by using problem posing better than who learned by using problem solving learning model. Students gave a positive response to implementation of the both learning models.

Keywords: problem posing, problem solving, conceptual understanding, problem solving skills.

INTRODUCTION

Learning of Salt hydrolysis materials are not only demand conceptual understanding but also algorithmic understanding. Conceptual understanding relate to understanding of theories, facts, rules, descriptions and chemistry terminologies as well as all related. Meanwhile, algorithmic understanding relate to understanding and applicating equations and mathematical calculations related to the chemistry concepts. Both of them plays an important role in studying chemistry. Because, due to in-depth understanding of chemical facts, students are required to master not only the quantitative aspect, but also the qualitative concepts. Various studies showed that most students have been mastered algorithmic understanding, but have not been understood chemistry concepts. As instance, Zoller (2001) found that student who success in solving algorithmic problems by no means have a good conceptual understanding in chemistry.

Generally, in our schools, students tend to have no learning readiness before receiving lessons and have lack understanding of related or prerequisite concepts. As a result, students only receive information provided by the teacher without involving construction of knowledge. Thus learning becomes meaningless and less students' activity to evaluate and think the truth of information as well as students' conceptual retention.

Learning process should direct and encourage students to develop thinking skills. The good thinking skills will result not only a good remembering and understanding the variety of data, facts, or concepts, but also ability of using data, facts, and concepts as a means to train thinking skills in problems solving.

Jacobsen, Egge and Kauchak (Primandari 2010) found that through problem solving exercises, students will learn to organize his ability in developing appropriate strategies to solve the problems. When solving the problem, students have to answer the question immediately, and pass through many stages using reason, logic and higher-order thinking and elaborate on all the prior knowledge and experience they have. Gabel and Samuel (Wolfer, 2000) said the main reason why students do not success in solving chemical problems is as they do not really understand the chemistry concepts. Actually, the depth concept possessed by the students will be able to make the students as "true solver".

The student's ability to solve the problem will contribute to their success in learning as well as be the important factors that support their success in the future life. In fact, the ability to solve problems can already be trained since the student’s at elementary school, through the proper scaffolding (Sholahuddin, et al., 2015). According to Jerald the 21st century education demand not only a strong foundation or 'core', in content knowledge but also the ability to apply it to the real world (literacies), and both are essential broader competencies like critical thinking and problem solving. In line with Jerald, Binkley classify them into four groups includes (1) thingking as creativity, critical thinking, problem solving and metacognition (2) working as communication and collaboration (3) information technology literacies are the tools for working and (4) citizenship, life skills, and personal responsibility are necessary for living in the world (Greenstein, 2012).

Problem posing and problem solving learning model are two of many learning model which have the main goal to develop problem solving skills. Problem posing learning model requires students to prepare their own question or solve a problem into questions that are more modest (Shoimin, 2014; Akay & Boz, 2010). Problem posing models is adapted to students' abilities so that it will build cognitive structures and motivate students to think critically (Norliawati, 2006). Meanwhile, the problem solving learning model requires students to solve the problems that be created by educators or real facts in daily life and then they must be solved in the classroom in various ways and techniques. According to Gagne (Wena, 2011) problem solving learning model allows one to increase the independence of his/her thinking.

The both learning model above equally focus on problem solving activity by encouraging students to involve actively in constructing their own new knowledge using their prior knowledge. When in the problem posing the presenting problems comes from the students themselves, conversly in the problem solving learning model they are pose by the teacher.

Although the main goal of the problem-based learning model is to train problem-solving skills, many studies have been examined the application of problem posing and problem solving learning models in the context of improving students' understanding to the concept. Widiartini (2012) reported that there are differences in learning motivation and understanding of chemistry concepts between students who learn by using problem posing and problem-solving learning model. According to Koeswardhani, et al. (2014) the use of problem posing learning model generate higher learning achievement than the use of problem solving learning model. In other study, Rahmini (2013) shows that there are differences in critical thinking skills, logical-mathematical intelligence, and mastery of concepts between students who learn salt hydrolysis material by using problem solving and conventional learning. This study examined differences in cognitive learning outcomes of salt hydrolysis material that include conceptual understanding and problem solving skills among students who learn by using problem posing and problem solving learning model.

METHODS

This research applied quasi-experimental research methods with pre-test-post-test comparison group design of two kinds of treatment. The research population was student of Mathematics XI SMAN 6 Banjarmasin and the sample is a class XI student of MIPA-3 as the experimental class I and a class XI MIPA-2 as the experimental class II were taken by cluster random sampling. The independent variable are the problem posing and problem solving learning model. The experimental class I lerned by using problem posing model in which students create and solve the problems by themselves with the teacher guiding. Whereas, the experimental class II by using problem solving model in which students learn the problems which were posed by the teacher. As dependent variabel, learning outcomes assessed using written test concise of conceptual understanding and problem solving skills according to Polya's model (1973). Furthermore, the data were analyzed using descriptive and inferential involves of percentage, and t test.

RESULTS AND DISCUSSION

Conceptual understanding tests were performed twice namely pre-test and post-test. Statistical analysis show that all the data were distributed normally dan homogenously. According to t-test analysis (α = 0.05), there are significant differences between students' conceptual understanding who learn by using problem posing and students' who learn by using problem solving learning model. The average score of conceptual understanding as presented in Figure 1.

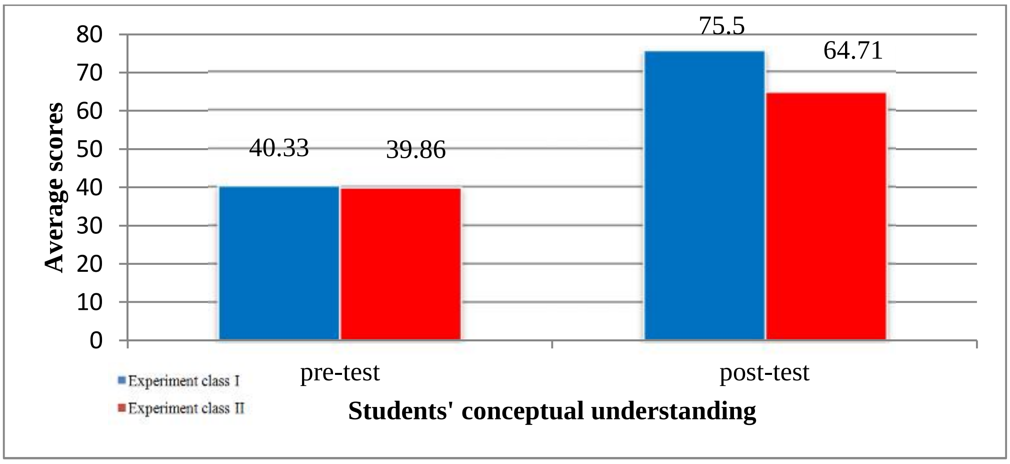
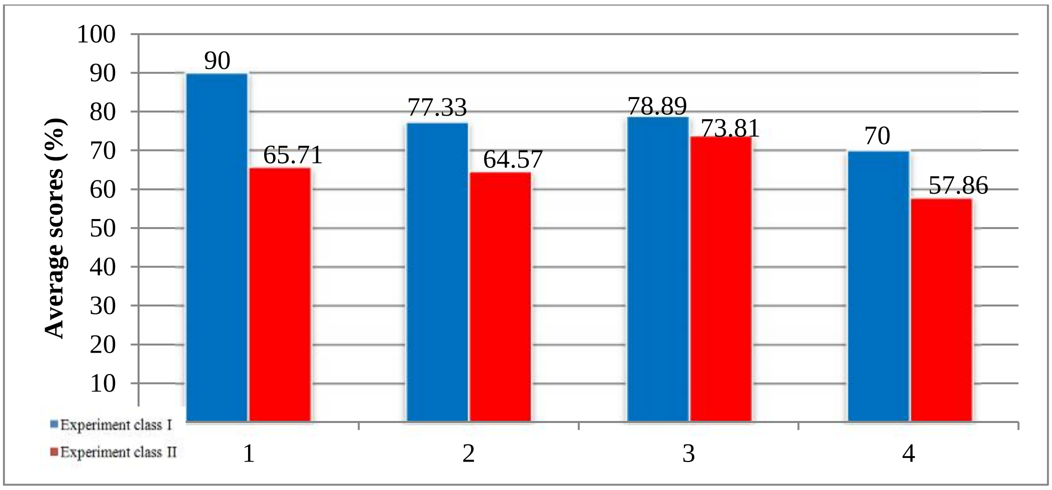


Figure 1 The average scores of conceptual understanding

The facts show that problem posing has a better potency than problem solving learning model for improving students' conceptual understanding of salt hydrolysis material. In the problem solving, students’ only solve the problem that is posed by the teachers, while in the problems posing students have to be able to formulate questions and also to be able to finish them well. This means that through the problem posing model students more involved in the learning process through analytical thinking either when they formulate questions or answer them. This results are consistent with Widiartini’s study (2012) that there are differences in learning motivation and understanding of chemical concepts between students who learn by using problem posing and problem-solving learning model.

The level of conceptual understanding of experiment class I and II based on it indicators is presented in Figure 2.



Description: 1 = Memorizing chemical information; 2 = Mastering chemistry concepts;3 = Mastering chemical rules; 4 = Mastering specific rules covering mathematical formulas and graphs

Figure 2. The level of conceptual understanding based on it indicators

Memorizing chemical information

The results showed that 90% of students experiment class I and 65.71% of students experimental class II answer the questions of this indicator correctly. This mean that experiment class I better than experiment class II in memorizing chemical information. In the problem posing learning model, students ask questions through independent learning. They repeated and practiced the matter independenly so it make them easier to remember information they learned. According to the information processing theory (Slavin, 2009) that involving students fully in the process and repetition (rehearsal) will provide an opportunity for information to be processed into long-term memory, so it will produce the strong conceptual retention. Middlecamp & Kean (1985) argue that looking for a pattern or rules will help students in memorizing conceps. Setiawati, et al. (2013) found that students' involvement in preparing the questions lead them to recall or restate a concept, classify objects according to certain properties in accordance with the concept.

Mastering chemistry concepts

A total of 77.33% students of experiment class I and 64.57% students of experiment class II answer the questions in this indicator correctly. It means that experimental class I better than experimental class II in mastering of chemical concepts. Learning by using posing problem model emphasizes students to form/submit questions based on information or situations that are given. The information that have been processed in mind and understood make the learners able to ask questions or pose the problems. That activities will make students more active and creative in constructing the knowledge, ultimately students' understanding of chemistry concepts better. This fact is in line with Jannah’s study (2013) that the application of problem posing can improve the conceptual understanding as to be seen from the student's ability to formulate problems and their ability to resolve the issue.

Mastering the chemistry rules

A total of 78.89% and 73.81% students of experiments class I and class II respectively, answer the questions on this indicator correctly. Students’ mastering of chemistry concept will be parralel to their mastering of chemistry rule, because the rules are the relationship between chemistry concepts. This is in line with the opinion of Middlecamp & Kean (1985) that in order to understand the chemistry rules it will require an understanding of the concepts underlying them. According to Herawati (2010) on the problem posing activity students create questions pertaining to the material that has been taught and to pose question or problems it is required a good mastery of the basic concepts.

Mastering the special (mathematical formulas and graphs)

Figure 2 shows that 70% students experiment class I and 57.86% students experiment class II answer the questions in this indicator correctly. It appears that the conceptual understanding of the experimental class I in this aspect better than the experimental class II. Problem posing will make students actively participate in class and allow them more think analytically. Cildir & Sezen (2011) said that the problem posing activity requires a mastery of the subject and look for relationships between components that can improve the understanding and impact to academic achievement.

The above facts prove the application of problems posing models gave a better effect on students' conceptual understanding than problem solving model. Conceptual understanding, will support students to develope their logical thinking ability, critical, creative and problem solving skills. Conversely, a good ability to solve problems will improve students' conceptual understanding. According to Norman and Burn (2011) among the advantages possessed by problem posing model is train the problem solving skills, improve students' conceptual understanding and efficacy because of the problems which are learned comes from the students themselves.

The average scores of students’ problem-solving skills in the experimental class I and experiment class II is presented in Figure 3

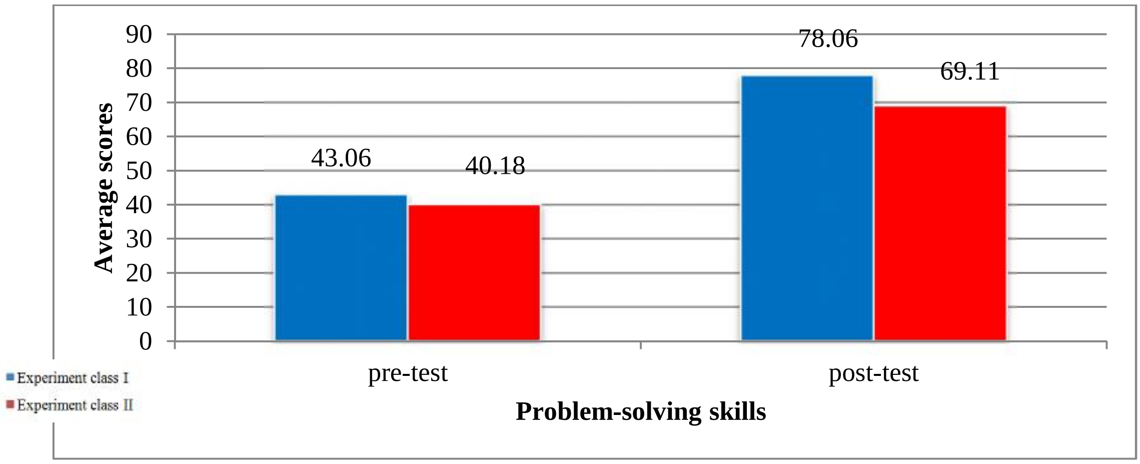


Figure 3 The average scores of students' problem-solving skills

Problem posing is one of the activities that can enable students to give an unsolved problem and ask students to complete it. Students are not only asked to submit questions, but they were asked to find their solution. Although both models equally train problem-solving skills, but problem posing involve students more in-depth from formulating problems to solve the problems gradually.

Based on the above results it can be said that learning that is facilitated by problem posing steps have been given effect in improving problem-solving ability in salt hydrolysis material better than problem solving one. The students' problem-solving skills in the form of understanding and defining problems, planning problem solving through analytical thingking by using knowledge and experience, executing planning or implementing strategy that has been planned, as well as reflecting the problem solving activities.

Example of problem that was solved by student as follow:

Problem:

In order for the plants to grow well, the soil pH should be kept as required for plant growth. Therefore we need a substance that can maintain the pH of the soil that is not too acidic or alkaline. A farmer has only fertilizers $(NH_4)_2SO_4$ *and he is known that the soil is alkaline.*

a) *What can a farmer use fertilizer* $(NH_4)_2SO_4$ *to reduce the soil pH? Prove your opinion by the ionization reaction!*
b) *If the farmer wants to obtain solution for watering the plant with the pH = 5, how much mass of* $(NH_4)_2SO_4$ *should be added to 100 ml of water? (Kb* $NH_3 = 10^{-5}$*, Ar H = 1, N = 14, O = 16, S = 32)*

Students are asked to solve the problem by answering the guided question concise of understanding problem, planning problem solving, executing planning, and reflecting or check back.

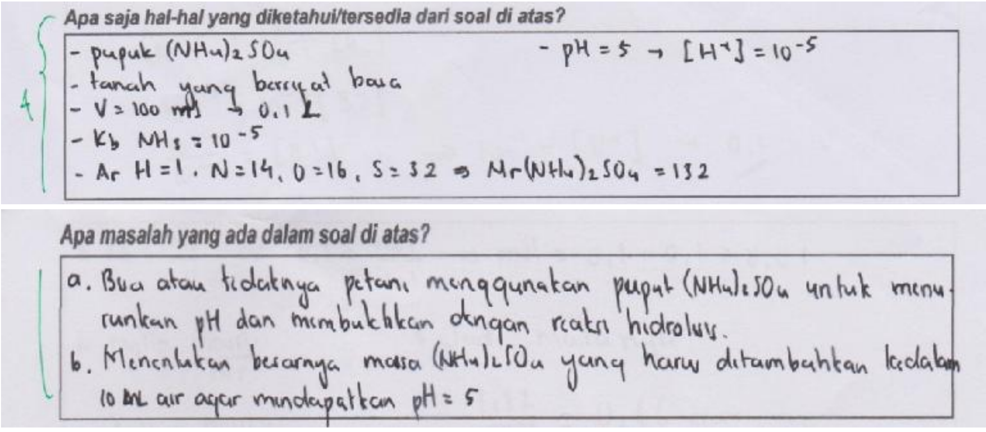
(1) Understanding problem

A. What are data that are known/available on statement above?

B. What is the actually problems in statements above?

The students' answer is considered appropriate or correct when they can write the data stated in in the problem complitely and accurately as well as explain the problem accurately suit to the problem to assist in determining the appropriate strategy to solve it.

Experiment class I

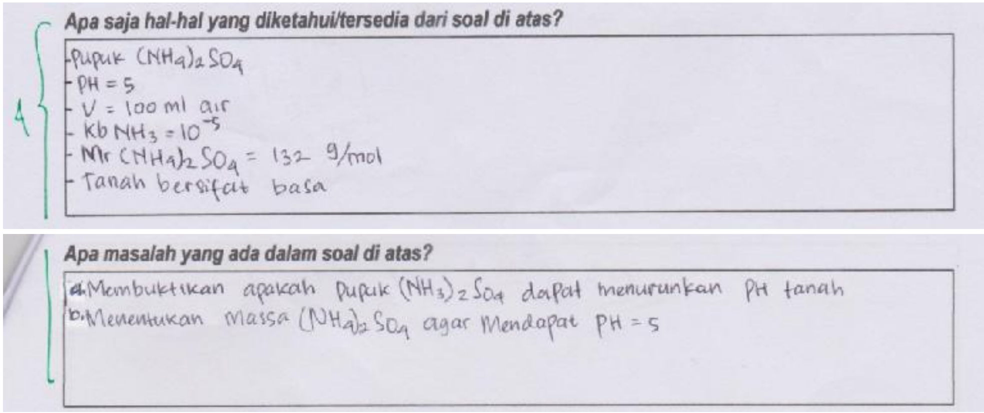

Apa saja hal-hal yang diketahui/tersedia dari soal di atas?

4
- pupuk $(NH_4)_2SO_4$
- tanah yang bersifat basa
- V = 100 ml → 0,1 L
- Kb $NH_3 = 10^{-5}$
- Ar H = 1, N = 14, O = 16, S = 32 ⇒ Mr $(NH_4)_2SO_4$ = 132
- pH = 5 → $[H^+] = 10^{-5}$

Apa masalah yang ada dalam soal di atas?

a. Bisa atau tidaknya petani menggunakan pupuk $(NH_4)_2SO_4$ untuk menurunkan pH dan membuktikan dengan reaksi hidrolisis.
b. Menentukan besarnya massa $(NH_4)_2SO_4$ yang harus ditambahkan kedalam 100 mL air agar mendapatkan pH = 5

Experiment class II


Apa saja hal-hal yang diketahui/tersedia dari soal di atas?

4
- Pupuk $(NH_4)_2SO_4$
- PH = 5
- V = 100 ml air
- Kb $NH_3 = 10^{-5}$
- Mr $(NH_4)_2SO_4$ = 132 g/mol
- Tanah bersifat basa

Apa masalah yang ada dalam soal di atas?

a. Membuktikan apakah pupuk $(NH_3)_2SO_4$ dapat menurunkan pH tanah
b. Menentukan massa $(NH_4)_2SO_4$ agar mendapat pH = 5

Figure 4 Sample of students’ understanding problem skills

Figure 3 describe that students in the experimental class I and II can write data to overcome the problem completely and accurately, as well as students are able to explain the problem appropriate to the statements.

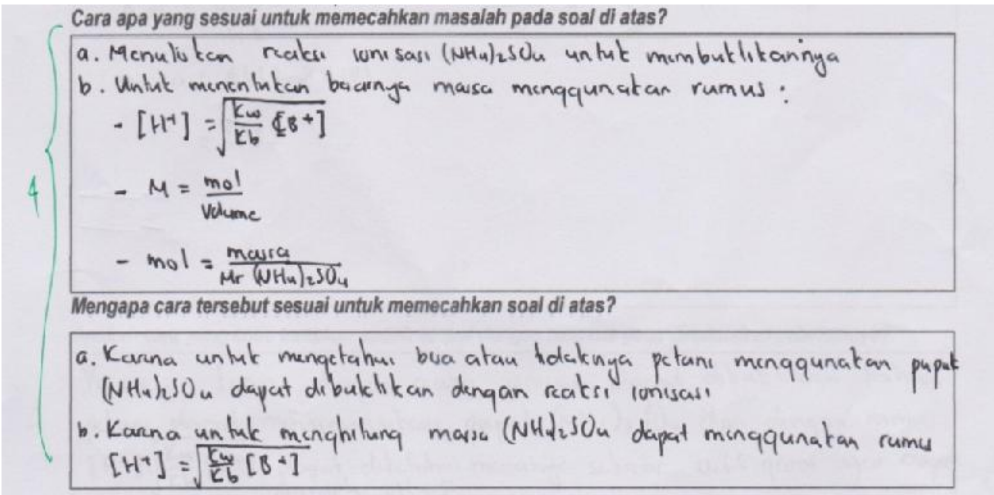
Planning problem solving

C. What is the appropriate way to solve the problem?

D. Why is it the appropriate way to solve the problem?

The students’ answer is considered appropriate or correct when they can determine the strategy and reasons for choosing a strategy that is suitable to solve the problem and lead to the correct answer.

Experiment class I


Cara apa yang sesuai untuk memecahkan masalah pada soal di atas?

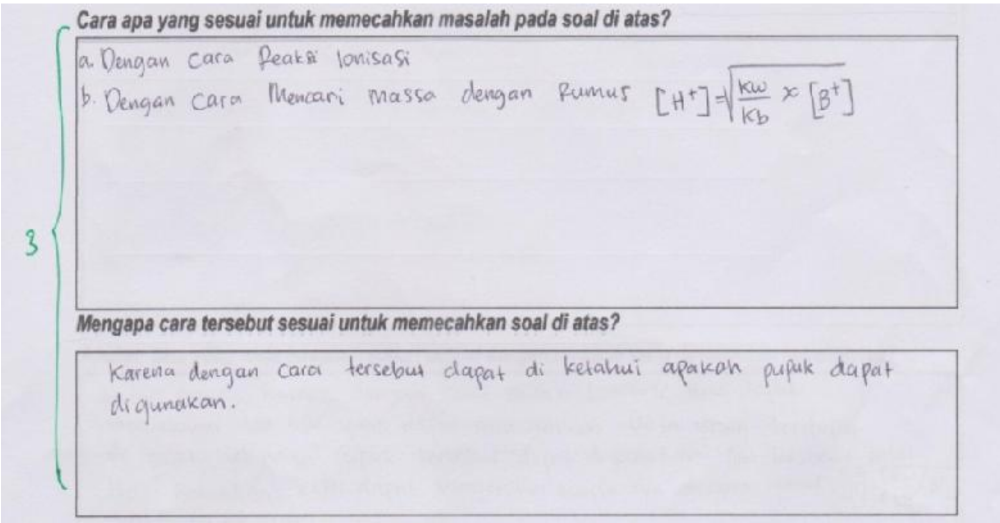
a. Menuliskan reaksi ionisasi $(NH_4)_2SO_4$ untuk membuktikannya
b. Untuk menentukan besarnya massa menggunakan rumus :
- $[H^+] = \sqrt{\frac{Kw}{Kb}[B^+]}$
- $M = \frac{mol}{Volume}$
- $mol = \frac{massa}{Mr\ (NH_4)_2SO_4}$

Mengapa cara tersebut sesuai untuk memecahkan soal di atas?

a. Karena untuk mengetahui bua atau tidaknya petani menggunakan pupuk $(NH_4)_2SO_4$ dapat dibuktikan dengan reaksi ionisasi
b. Karena untuk menghitung massa $(NH_4)_2SO_4$ dapat menggunakan rumus $[H^+] = \sqrt{\frac{Kw}{Kb}[B^+]}$

4

Experiment class II


Cara apa yang sesuai untuk memecahkan masalah pada soal di atas?

a. Dengan cara Reaksi Ionisasi
b. Dengan cara Mencari massa dengan Rumus $[H^+] = \sqrt{\frac{Kw}{Kb}} \times [B^+]$

Mengapa cara tersebut sesuai untuk memecahkan soal di atas?

Karena dengan cara tersebut dapat di ketahui apakah pupuk dapat digunakan.

3

Figure 5 Example of students' planning problem solving skills

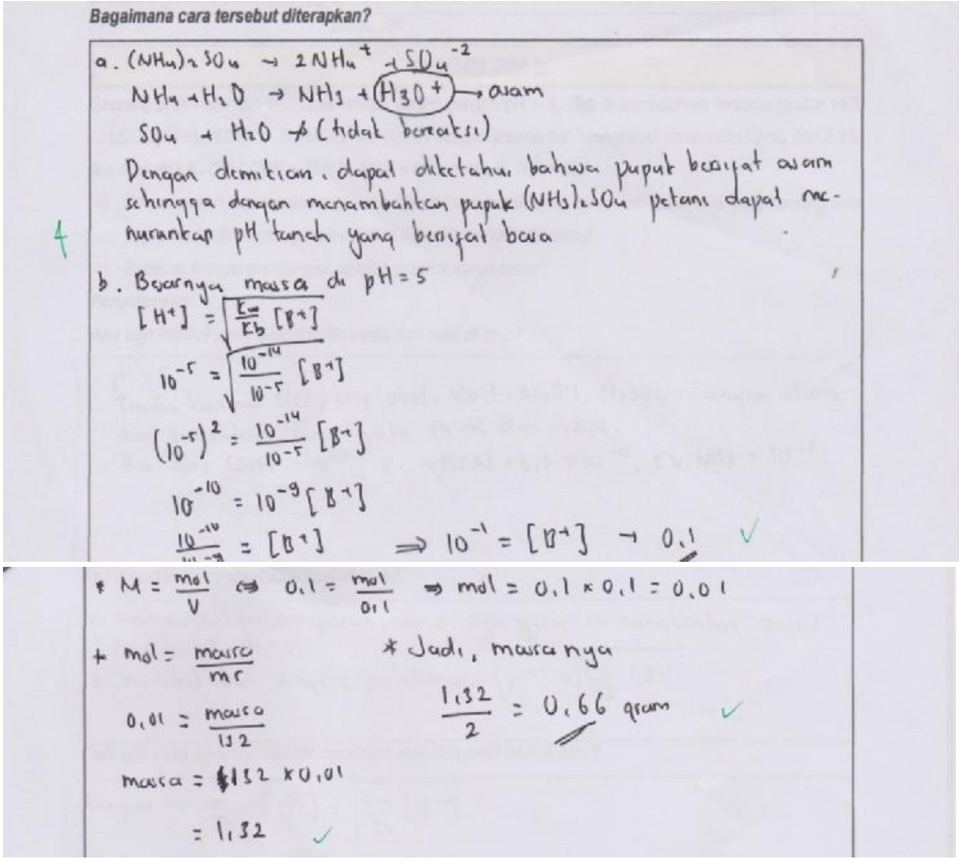
Thus example discribe that the students of the experimental class I can determine strategies appropriately and detail. He also provide reasons to choose the right strategy to solve the problem. Meanwhile, the students of experimental class II can determine the right strategy, but has not given the reason for choosing the right strategy to solve the problem.

Executing Planning

E. How can your planning be applied?

The students' answer is considered appropriate or correct when students can solve the problem exactly as he planned.

Experiment I



Bagaimana cara tersebut diterapkan?

a. $(NH_4)_2SO_4 \rightarrow 2NH_4^+ + SO_4^{-2}$

$NH_4 + H_2O \rightarrow NH_3 + H_3O^+ \rightarrow$ asam

$SO_4 + H_2O \not\rightarrow$ (tidak bereaksi)

Dengan demikian, dapat diketahui bahwa pupuk bersifat asam sehingga dengan menambahkan pupuk $(NH_4)_2SO_4$ petani dapat menurunkan pH tanah yang bersifat basa

4

b. Besarnya massa di pH = 5

$[H^+] = \sqrt{\frac{K_w}{K_b}[B^+]}$

$10^{-5} = \sqrt{\frac{10^{-14}}{10^{-5}}[B^+]}$

$(10^{-5})^2 = \frac{10^{-14}}{10^{-5}}[B^+]$

$10^{-10} = 10^{-9}[B^+]$

$\frac{10^{-10}}{10^{-9}} = [B^+] \Rightarrow 10^{-1} = [B^+] \rightarrow 0,1$

* $M = \frac{mol}{V} \Leftrightarrow 0,1 = \frac{mol}{0,1} \Rightarrow mol = 0,1 \times 0,1 = 0,01$

* $mol = \frac{massa}{mr}$

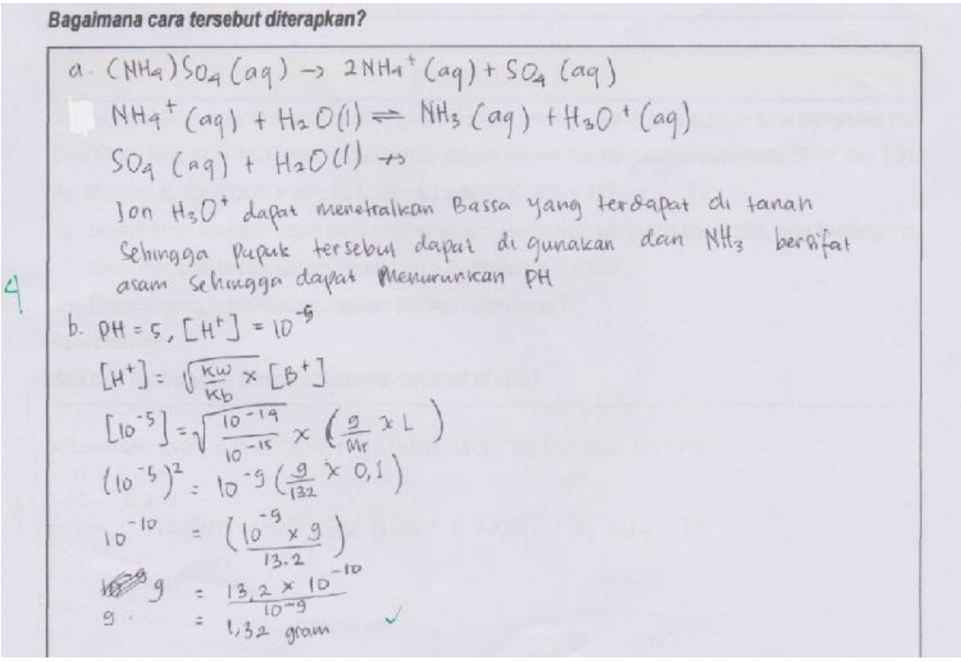
$0,01 = \frac{massa}{132}$

massa = $132 \times 0,01$

= 1,32

* Jadi, massanya $\frac{1,32}{2} = 0,66$ gram

Experiment II



Bagaimana cara tersebut diterapkan?

a. $(NH_4)SO_4 (aq) \rightarrow 2NH_4^+ (aq) + SO_4 (aq)$

$NH_4^+ (aq) + H_2O(l) \rightleftharpoons NH_3 (aq) + H_3O^+ (aq)$

$SO_4 (aq) + H_2O(l) \not\rightarrow$

Ion H_3O^+ dapat menetralkan Bassa yang terdapat di tanah sehingga pupuk tersebut dapat di gunakan dan NH_3 bersifat asam sehingga dapat Menurunkan PH

4

b. $pH = 5, [H^+] = 10^{-5}$

$[H^+] = \sqrt{\frac{K_w}{K_b} \times [B^+]}$

$[10^{-5}] = \sqrt{\frac{10^{-14}}{10^{-15}} \times \left(\frac{g}{Mr} \times L\right)}$

$(10^{-5})^2 = 10^{-9}\left(\frac{g}{132} \times 0,1\right)$

$10^{-10} = \left(\frac{10^{-9} \times g}{13.2}\right)$

$g = \frac{13,2 \times 10^{-10}}{10^{-9}}$

$g = 1,32$ gram

Figure 6 Example of students' executing planning skills

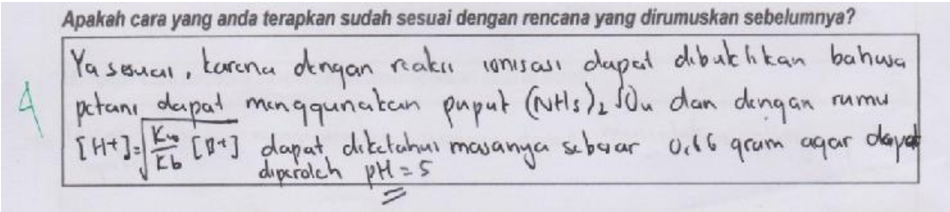
Figure 5 above discribe that students in the experimental class I and II experiments can implement the appropriate strategy planning for solving the problem. Students write ionization reaction to prove whether the farmer can use fertilizers $(NH_4)_2SO_4$ to reduce the soil pH and determine the amount of it mass to be solved in 100 ml of water using a calculation formula that had been planned.

Reflecting or check back

E. Is you strategy applied is appropriate to the planning?

The students' answer is considered appropriate or correct when students can check back to the problem solution.

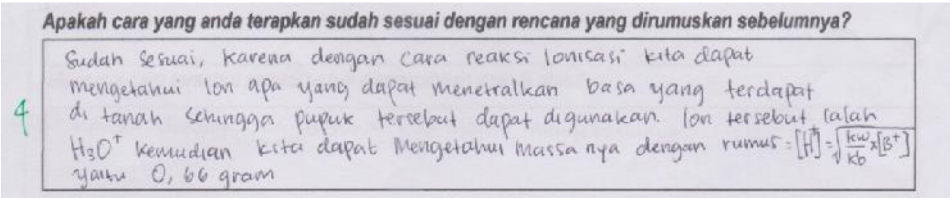
Experiment I


Apakah cara yang anda terapkan sudah sesuai dengan rencana yang dirumuskan sebelumnya?

4

Ya sesuai, karena dengan reaksi ionisasi dapat dibuktikan bahwa petani dapat menggunakan pupuk $(NH_4)_2SO_4$ dan dengan rumus $[H^+] = \sqrt{\frac{K_w}{K_b}[B^+]}$ dapat diketahui massanya sebesar 0,66 gram agar dapat diperoleh pH = 5

Experiment II


Apakah cara yang anda terapkan sudah sesuai dengan rencana yang dirumuskan sebelumnya?

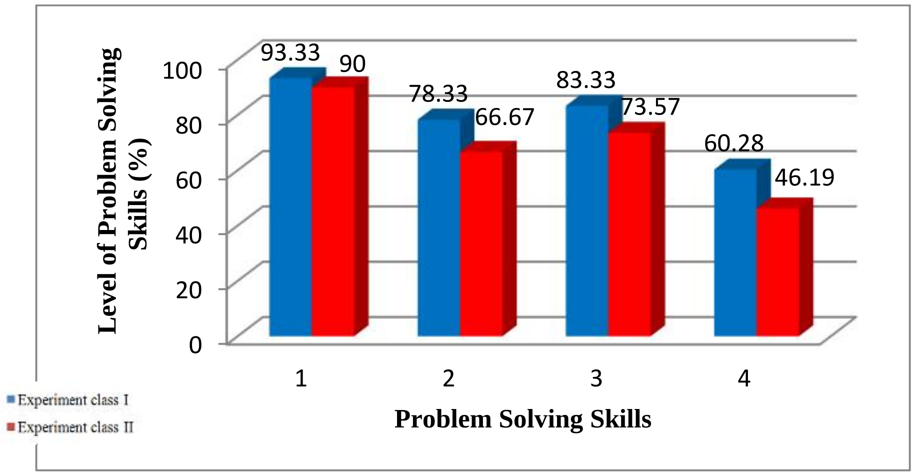
4

Sudah sesuai, karena dengan cara reaksi ionisasi kita dapat mengetahui ion apa yang dapat menetralkan basa yang terdapat di tanah sehingga pupuk tersebut dapat digunakan. Ion tersebut ialah H_3O^+ kemudian kita dapat mengetahui massa nya dengan rumus: $[H^+] = \sqrt{\frac{K_w}{K_b} \times [B^+]}$ yaitu 0, 66 gram

Figure 7 Example of students' reflecting skills

Figure 6 discribed that students in the experimental class I and class II stated that the implementation of the strategy was appropriate and in accordance with the plan.

The level of students' problem-solving skills in the experimental class I and class II base on their indicators is presented in Figure 8.



Description: 1. Understanding problem, 2. Planning problem solving, 3. Executing planning 4. Reflecting

Figure 8 The level of students' problem solving skills base on their indicators

Understanding problem

The level of problem solving skills of experimental class I and II are 93.33% and 90.00% respectively. Both are classified in the very good category eventhough the former have a greater level than the last. Problem posing makes students more active in formulating and resolving the problems. Students explore the interesting ideas that they thinks freely. If students can pose the questions, they are considered to understanding the problems. Problem posing traine students to create the problems and then solve them by other groups. When students formule a problem, they are required to understand the concept that has been received, as well as when they solve the problems that have been created by other groups. English in Ramdhani (2012) explains that the problem posing can help students develop their confidence and preference to mathematics, because they tried to implemented matematical ideas to understand the problems and improve their performance in problem solving.

Planning problem solving

The level of planning problem solving skills of experimental class I and II are 78.33% and 66.67% respectively. The former is classified in the enough category, while the last is classified in the poor category. Cankoy and Darbaz (2010) stated that the problem posing gives advantages to students in terms of acquiring knowledge by analyzing a problem. Planning problem solving require students to implement their thinking skills in connecting descriptions of their analysis results and gather a wide range of possibilities to solve the problem, led by his own experience. Then, they consider the possibilities of an answer or hypothesis with it consequences.

Executing Planning

The level of executing planning skills of experimental class I and II are 83.33% in good category and 73.57% in enough category respectively. When students create the questions, students are required to understand the questions well. This is the first step in solving a problem. Then, the students have to make the planning and solve the posed problems. Based on current research, according to Winograd (Lin, 2004), giving assignments to students to create questions can improve their ability to solve problems and their attitudes toward mathematics.

Reflecting

The level of reflecting skills of experimental class I and II are 60.28% in poor category and 46.19% in very poor category respectively. It mean that chemistry teacher have to more and more habituate students in reflecting activities continually. Reflecting skills will strengtenth students' critical thingking, honesty and responsibility character. At this stage, student ask to evaluate the solutions that have been done in accordance with their planning. It means that students should be responsible to their problems solving. According to English (Kurniasari, 2012) posing the problem may encourage students to be more responsible in their learning.

Generally, this discussion above shows that students who learn by using problem posing have the problem-solving skills better than who learn by using problem solving learning model.The students problem-solving skills indicators which need to be improved trough teaching and learning process are planning and reflecting.

Students responded positively to both of application of the learning models as presented in Figure 9.

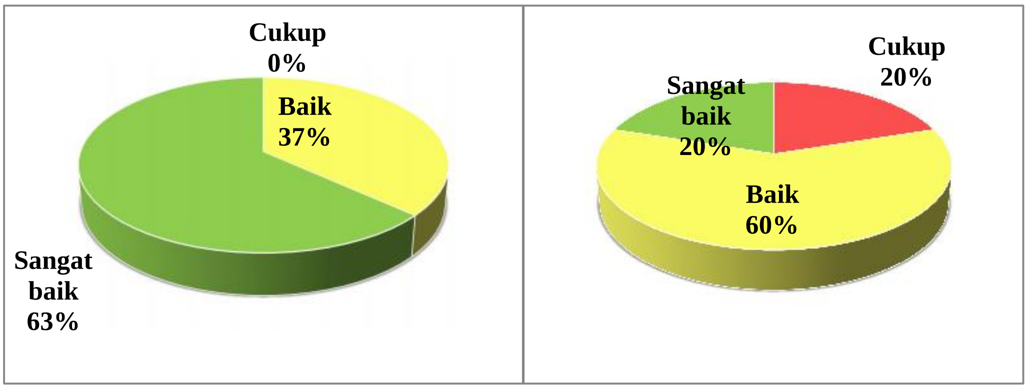


Figure 9 Students' response to implementation of (a) problem posing (b) problem solving learning model.

All the students of class experiment I gave a respond in good and exellent category, while 80% of students of experiment class II gave a respond in good and excellent categories. In other words, students more interested to problem posing compared to problem solving learning model. The application of the problem posing learning model, for students who have exellent thinking skills will provide opportunities for intellectual exploration. They will be challenged to find and to deepen information, so that questions they posed have answers more complex. While, for students with the average or low thinking skills will make a problem with a level of difficulty according to his ability. Shoimin (2014) argue that learning by using problems posing model may increase student motivation for learning so it will create an active learning, students will not get bored and be more responsive and finally they reach the better learning outcome.

Some of the difficulties encountered in the application of problem posing learning models on salt hydrolysis material among others most of the students still do not understand well the prerequisite concepts, acid-base, thus it hindered salt hydrolysis learning; problem posing require a long time so it need a precisely learning disign; at the beginning of learning some students are still not focused because students are still not accustomed to follow the learning model. Consecuenly, majority of students become passive and depend on their group or friends. It mean that for implementing problem posing model it need to consider and train the students by the basic skills that require in formulating questions and problem solving like information access, pose the ideas, discussion, and cooperative learning, gradually. But, the appropriate planning problem posing made the students have a lot of experience in solving the problems so that their conceptual understanding growed, and students' ability to solve the problems also increased.

CONCLUSION

There are differences in conceptual understanding and problem solving skills significantly between students learned by using problem posing and problem solving learning models. The students's cognitive learning outcomes who learned by using problem posing better than who learned by using problem solving learning models. Students gave a positive response to implementation of the both learning models.

REFFERENCES

Akay, H. & Boz, N. 2010. The Effect of Problem Posing Oriented Analyses-II Course on the Attitudes toward Mathematics and Mathematics Self-Efficacy of Elementary Prospective Mathematics Teachers. *Australian Journal of Teacher Education*. 35.

Cankoy, O. & Darbaz, S. 2010. Effect Problem Posing Based on Problem Solving Instruction on Understanding Problem. *Journal of Education.* 38:11-24.

Cildir, S & Sezen, N. 2011. A Study on the Evaluation of Problem Posing Skills in Terms of Academic Success. *Science Direct*. 15: 2494-2499.

Greenstein, L. 2012. *Assesing 21st Century Skills: A guide to evaluating mastery and authentic learning*. London: Corwin A Sage Company

Herawati, O. D. P. 2010. Pengaruh Pembelajaran *Problem Posing* terhadap Kemampuan Pemahaman Konsep Matematika Siswa Kelas XI IPA SMA Negeri 6 Palembang. *Jurnal Pendidikan Matematika.* 4(1): 70-80.

Jannah, R. 2013. *Meningkatkan Kemampuan Berpikir Kritis Dan Hasil Belajar Siswa Kelas XI IPA 1 SMA Negeri 6 Banjarmasin Pada Materi Kelarutan Dan Hasil Kali Kelarutan Melalui Pendekatan Problem Posing Tahun Pelajaran 2012/2013*. Skripsi Sarjana. Banjarmasin: FKIP Unlam.

Koeswandhani, Y., B. Mulyani, dan M. Masykuri. 2014. Pengaruh Model Pembelajaran *Problem Solving* dan *Problem Posing* pada Pokok Bahasan Konsep Mol terhadap Prestasi Belajar Siswa Kelas X Semester Genap SMA Negeri 6 Surakarta Tahun Pelajaran 2013/2014. *Jurnal Pendidikan Kimia.* 4(1): 38-43.

Kurniasari. I. 2012. Perangkat Pembelajaran Dengan Model Pembelajaran Matematika Berbasis Pengajuan dan Pemecahan Masalah Untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa Sekolah Dasar Kelas IV SDN Jati Sidoarjo. *Jurnal pendidikan Matematika*. 3:500-512.

Lin, P. 2004. Sopporting teachers on Designing Problem-Posing Task as a Tool of Assessment to Understand Students' Mathematical Learning. *Proceeding of the 28th Conference of The International Group for The Psychology of Mathematics Education.* 3: 257-264.

Middlecamp, C & Kean, E. 1985. *Panduan Belajar Kimia Dasar*. Jakarta: Gramedia.

Norliawati. 2006. *Implementasi Pendekatan Problem Posing pada Pembelajaran Konsep Ikatan Kimia Siswa Kelas X MAN 2 Model Banjarmasin Tahun Pelajaran 2005/2006*. Skripsi Sarjana. Banjarmasin: Universitas Lambung Mangkurat.

Norman, I. & Bakar, M. N. 2011. Secondary School Students' Problem Posing Strategies: Implications To Secondary School Students' Problem Posing Performances. *Journal of Edupres.* 1: 1-8.

Polya.1973. *How to Solve It*. New Jersey: Princeton University Press.

Primandari, A. H, 2010. *Upaya Meningkatkan Kemampuan Pemecahan Masalah Siswa Kelas VII SMPN 2 Nanggulan dalam Pembelajaran Matematika Pokok Bahasan Bangun Ruang Menggunakan Model Pembelajaran Kooperatif Tipe Think-Pair-Square.* Skripsi Sarjana. Yogyakarta: Universitas Negeri Yogyakarta.

Rahmini, A. 2013. *Pengaruh Model Problem Solving Terhadap Peningkatan Keterampilan Berpikir Kritis dan Kecerdasan Logis-Matematis Siswa pada Pembelajaran Materi Hidrolisis Garam Kelas XI IPA SMA Negeri 2 Banjarmasin Tahun Ajaran 2012/2013*. Skipsi Sarjana. Banjarmasin: FKIP Unlam.

Ramdhani, S. 2012. *Pembelajaran Matematika dengan Pendekatan Problem Posing untuk Meningkatkan Kemampuan Pemecahan Masalah dan Koneksi Matematis Siswa*. Skripsi Sarjana. Bandung: Universitas Pendidikan Indonesia.

Setiawati, T., S. Sutiarso, dan P. Gunowibowo. 2013. Pengaruh Strategi Problem Posing terhadap Pemahaman Konsep Matematis Siswa. *Jurnal Pendidikan Matematika*. 2:1-7

Shoimin, A. 2014. *68 Model Pembelajaran Inovatif dalam Kurikulum 2013*. Yogyakarta: Ar-ruzz Media.

Sholahuddin, A, Yuanita, L dan Kardi, S. 2015. *Efektivitas Strategi Pembelajaran @UnESa-GAIn pada Pembelajaran Materi Konduktor dan Isolator di Sekolah Dasar*. Seminar Nasional. Surabaya: PPS Unesa

Slavin, R. I. 2009. *Education Psycology*. 9th edition. New Jersey: Pearson.

Wena, M. 2011. *Strategi Pembelajaran Inovatif Kontemporer. Jakarta:* Bumi Aksara.

Widiartini, I. A. P. 2012. *Studi Komparatif Model Pemecahan Masalah dan Pengajuan Masalah terhadap Motivasi Belajar dan Pemahaman Konsep Kimia Siswa SMA*. Makalah. Bali: Universitas Pendidikan Ganesha.

Wolfer, A. J. 2000. *Introductory College Chemistry Students' Understanding of Stoichiometry; Connections Between Conceptual and Computational Understandings and Instruction.* Oregon State University: A Thesis Report, In Partial Fulfillment of the requirements for the degree of Doctor of Philosophy.

Zoller, U. 2001. Alternative Assessment As (Critical) Means of Facilitating HOCS-Promoting Teaching And Learning In Chemistry Education. *Chemistry Education: Research And Practice In Europe*, 2(1): 9-17.

USING METACOGNITIVE SKILLS IN LEARNING CHEMISTRY THROUGH PROBLEM SOLVING

Syahmani
Study Program of Chemistry of FKIP UNLAM Banjarmasin
Email: syahmani0168@gmail.com

ABSTRACT

Have been done study about using metacognitive skills in learning chemistry through problem solving. Metacognition is the awareness of cognitive processes. By using metacognition, someone does all the activities with full awareness. When students learning chemistry by involving their metacognitive skills, students will be able to observe the relationship between data in the problem with the prior knowledge, to re-examine its accuracy, aswell as solving a complex problem with the simple steps, tries to regulate and improve their cognitive processes. This paper aims is prepared in order to build a mindset learning chemistry through problem solving that involve students metacognitive skills. Metacognitive skills to form a competent student resources, who perform all acts by full awareness. always make good representing problem, planning, monitoring, evaluating, and transfering their action**.** The i-SMART model helps students to solve problems in a systematical way and supported scaffolding metacognitive questioning. So**,** metacognitive support during the solution process in problem solving chemistry more effective..

Keywords: Metacognitive Skills, Problem Solving, Awareness, Learning Chemistry.

INTRODUCTION

Many chemistry problems require students to understanding chemical concepts and translate word problems into mathematical statements (Chandrasegaran *et al.*, 2009). Learning chemistry about new concepts can not be separated from the learning concepts in the representation (Tytler *et al.*, 2013). To solve the problem of learning chemistry, especially chemical concepts that contain lots of mathematical and graphical content, should be macroscopic, sub-microscopic and symbolic levels (through a chemical equation, mathematics, graphics, diagrams, and dynamic visual) is represented well in the classroom.

The development of problem solving related to students' metacognition. Metacognition as the study of self-awareness and reflection on cognitive processes, the ability to monitor, regulate and evaluate one's thinking (Brown, 1987). Cooper, Sandi-Urena and Stevens (2008), namely: "metacognition is fundamental in achieving of chemistry and developing of the problem of skills." Bell (2008) has identified eight types of episodes of solving problems, namely: reading was categorized as cognitive, understanding as metacognitive, analyzing as metacognitive, exploring as either cognitive or metacognitive, planning as metacognitive, implementation as either cognitive or metacognitive, verifying as either cognitive or metacognitive, and watching-and-listening was not assigned a cognitive level. Metacognition has an important role in the process of solving problem (Rickey & Stacy, 2000). Others research shows that cueing a student to be metacognitive can help the student to improve his problem-solving skills (Conner, 2007; Kapa, 2002). For example, Kapa (2002) found that when students were cued during a task they became more successful in problem-solving activities than students who were cued only afterwards.

Metacognition skills refers to planning, monitoring, and evaluation skills (Brown, 1987; Cooper & Sandi-Urena, 2009; Delvecchio, 2011). Opinions expressed similar Whitebread, et al. (2009) and Moreno (2010) that metacognition skills include planning, monitoring and evaluation or regulation. Application of metacognition in learning is to involve students in understanding, reflection and feedback. Representation competence is essential for meaningful understanding in solving chemistry problems (Vicente, 2011). Students often uses representations such as pictures, charts, and diagrams to help understand the problem before using mathematical equations to solve quantitative problems (Corolan et al., 2008). Reflection learning happens when students are engaged in the process of thinking about thinking and practice in a critical way, to learn from the process, and apply what is learned to improve future action. Teachers can use the feedback to help students improve the quality of work, perceptions of competence, self-determination and intrinsic motivation (Moreno, 2010).

Metacognitive skills also related to transfer skills what they learned to new situations will be improved when students are more aware of themselves as learners actively monitor learning strategies and knowledge (Moreno, 2010). Billing (2007) states that transfer of metacognitive strategies is enhanced when learners notice that problems resemble each other and when learners are expected to solve the problems themselves. Conner (2007) claims that when students acquire metacognitive skills in certain contexts these skills can be beneficial in other contexts as well.

Much research has been conducted focusing on the problems solving of learning chemistry, but until now the problems that still continue to appear. For this reason, this paper is prepared in order to build a mindset to solve the problem of learning chemistry using metacognitive skills. Because the students 'knowledge of the process of cognition and metacognition skills will maximize students' potential to think and learn in regulating cognition, to guide them in representing problem, planning the learning environment, choosing strategies, monitoring, evaluating, and transfering to improve cognitive performance in future.

METHOD

The paper was written in a narrative based on the results of studies and reviews some of the literature, the results of research as well as some of the experts thought of learning-oriented model of metacognition and problem solving chemistry. Analysis and synthesis of how the scientific literature, such as journals, research reports, and proceedings.

DISCUSSION

i-SMART Model is an Alternative Solution in Learning Chemistry

Paradigm of the XXI century education requires students to have metacognition skills in global competition. Researchers will develop indicators metacognitive skills described by Polya (1973), Mac Gregor (2007), (Erskine, 2009), Moreno (2010), Delvecchio (2011), Vicente (2011), and Sousa (2012) to five aspects of metacognition skills in Table 1.

Table 1 Aspects dan indicators of metacognitive skills

Aspects of Metacognitive	**Indicators**	**Operational Definition**
Representing the problem)	a) Write down what is known or information in the problem b) Simply the problem into the form of images or represent-tations of (macroscopic,	Students can identify, formulate and represent the problem.
Planning	a) Making predictions. b) Choossing and preparing strategies, tool materials to be used.	Students can plan a problem solving strategies.
Monitoring	a) Identifying the tasks. b) Checking implementation strategy to problem and the results. c) Deciding something done has been understood.	Students can understand, implement strategies, and problem solving systematically monitor.
Evaluating	a) Determining the achievement of learning objectives. b) Reflecting itself from the process (learning	Students can evaluate themselves in problem solving
Transfering	a) Using the different methods to solve the same problem. b) Using the the same method to solve different	Students can transfe strategy/knowledge from one level domain to anothe

Exercises such skills can be facilitated through the phases of learning: ***I****dentifying and representing problem*, ***S****electing strategies and plans*, ***M****aking investigation with monitoring strategy use*, ***A****nalyzing*, ***R****eflecting and evaluating*, dan ***T****ransfering*. This model is named i-SMART (Figure 2.1), designed to create the reinforcement metacognition skills through problem solving in line with the implementation of Curriculum 2013.

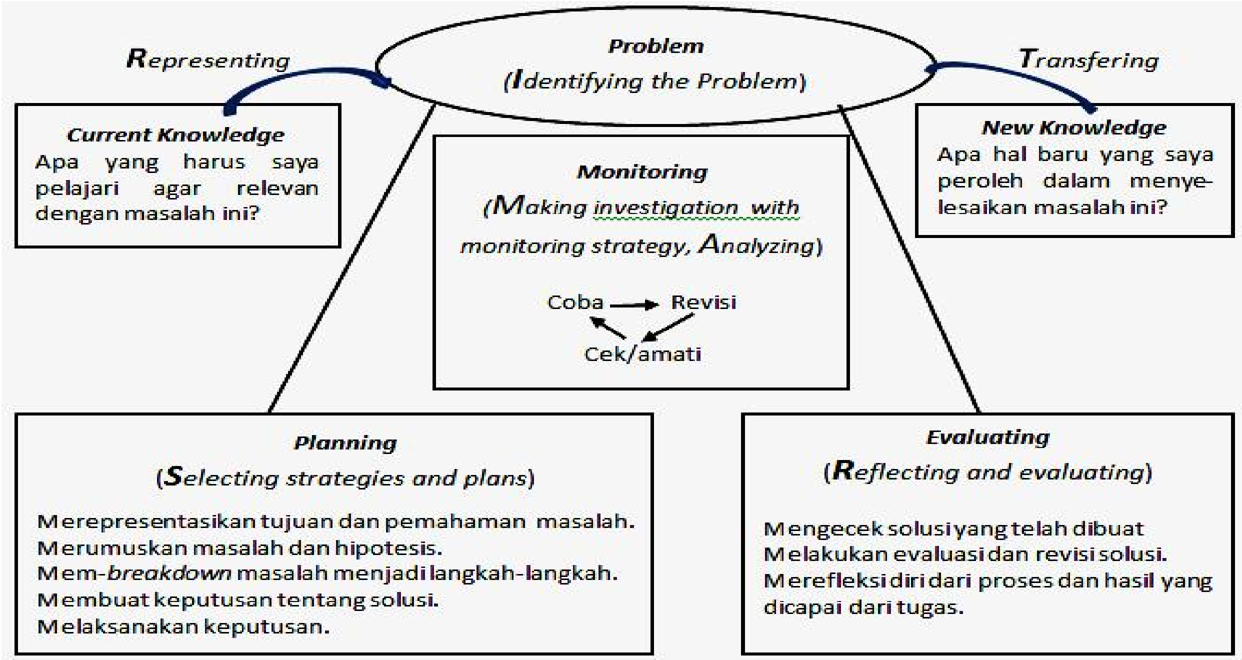


Figure 1 Fremework of Training Metacognitive Skills (modified from Delvecchio, 2011; Java, 2014).

i-SMART model is supported primarily Vygotsky's theory of collaborative interaction with scafollding principles and Piaget's theory of mental function adaptation. Ernest (1991) explained that the reconstruction of the knowledge of students through four stages. First, objective knowledge is represented students with constructing a circular (with groove investigate, explain, expand, evaluate) resulting in the reconstruction of the initial conception. Second, the initial conception as a result of the reconstruction of the individual is subjective knowledge. Third, the subjective knowledge collaborated with other students, teachers and the learning that occurs as a result of the process of reconstruction scaffolding. Fourth, the concept of chemical reconstructed as a result of the scaffolding represented as a group of new knowledge.

Piaget's theory of mental function adaptation, done by a process of assimilation and accommodation. Students are in the process of assimilation using existing cognitive structures to respond so that there is an imbalance of cognitive on students. Students will interact with existing data on the environment to be processed in the mental structure. The student mental structure in processing the data, may change resulting in accommodation. The investigation activities for example in learning chemistry lab is an effort to accommodate that observed events will make it easier assimilation (Renner et al, 1988). Students must be able to connect new concepts to learn and understand concepts with other concepts in a relationship between concepts (network of relationships). The new concepts must be organized with other concepts that have been owned by the students. Good organization will be reflected in the responses given to the problems faced to form a new concept (equilibrium) in learning.

i-SMART models developed has syntax that consists of six stages. Metacognition skills trained through metacognitive questions on each phase of i-SMART model.

Details of the syntax stage i-SMART models are as follows.

1. Identifying and representing problem

The level of cognitive development affects the student's ability to identify and represent the problem. Actually, problem solvers activate their previous interpretations about the problem concepts while reading the problem text. Representing the problem mentally (or visualization problem with a computer program) in a form that is close to optimal for problem solution. This is single most valuable of the metacognitive skills: How an individual states the problem is a prime determinant of success in solving it.

2. Selecting strategies and plans

Selection of a problem-solving strategies. There are many ways to solve problems. Good problem solvers know many strategies, and they have the ability to select wisely, choosing procedures for solving the particular problems of the specific domain.

3. Making Investigation with Monitoring Strategy Use

Strategic application of problem-solving methods through investigation. Good problem solvers have strategies for solving the problem. They apply a potentially effective method/strategy, constantly monitoring the changes in problem state that the method produces to see if a solution has occurred. They know what they will try next, and why. During this step, students are asked to reread about to make a solution. This phase includes *try-revise-check* activities.

4. Analyzing

Ask students to analyze the data, assisted with the question "How the experimental data can be explained ", Then summarize and communicate/presented the results of the group in front of the class, another group of students was asked to respond.

5. Reflecting and evaluating

The evaluation process involves the interaction of a person, a solution and a strategy. Evaluation of cognitive learning, metacognitive skills, the mission-planning process, good problem solvers evaluate potential solutions, to see if the discrepancy between goal state and current state has been reduced. Yet, using an evaluating process might encourage students to reflect on problem solving through discussion and perhaps find another approach to the specific problem, eventually leading to a final solution that might be more elegant. The evaluation potential could be restricted if the students lack the knowledge resources.

6. Transfering

Learning in the context of the knowledge that has been owned, or transferring, use and build upon what has been controlled by the students through assignments in different settings. Students have completed the enrichment given by the task group that is the challenge to make new proposals are implementable.

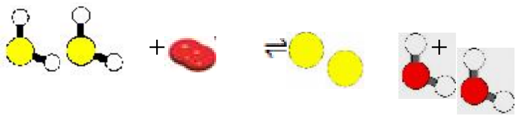
Illustration Students Use Metacognitive Skills in Problem Solving Chemistry

Based on the description that metacognition has an important role in the process of solving problem in learning of chemistry should be prefixed with the grain problem, the need to metacognitive skills. Chemistry learning that foster metacognitive skills are implementing learning chemistry by growing awareness and knowledge of students' thinking processes and activities in every phase of problem solving through the following steps.

Sample Problem 1. Predicting the effect of a change in concentration on the equilibrium position.

Problem. To improve air quality and obtain a useful product, chemists often remove sulfur from coal and natural gas by treating the fuel contaminant hydrogen sulfide with O_2

$2H_2S_{(g)} + O_{2(g)} \rightleftharpoons 2S_{(s)} + 2H_2O_{(g)}$ What happens to:



(a) $[H_2O]$ if O_2 is added? **(b)** $[H_2S]$ if O_2 is added? **(c)** $[O_2]$ if H_2S is removed? **(d)** $[H_2S]$ if sulfur is added? (Silberberg, 2009).

Planning. We write the reaction quotient to see how Q_c is affected by each disturbance, relative to K_c. This effect tells us the direction in which the reaction proceeds for the system to reattain equilibrium and how each concentration changes.

Appying strategy. Writing the reaction quotient: $Qc = \frac{[H_2O]^2}{[H_2S]^2[O_2]}$

a) When O_2 is added, the denominator of Q_c increases, $Q_c < K_c$. The reaction proceeds to the right until Q_c = Kc again, so $[H_2O]$ increases.

b) As in part (a), when O_2 is added, $Q_c < K_c$. Some H_2S reacts with the added O_2 as the reaction proceeds to the right, so $[H_2S]$ decreases.

c) When H_2S is removed, the denominator of Q_c decreases, so $Q_c > K_c$. As the reaction proceeds to the left to re-form H_2S, more O_2 is produced as well, so $[O_2]$ increases.

d) The concentration of solid S is unchanged as long as some is present, so it does not appear in the reaction quotient. Adding more S has no effect, so $[H_2S]$ is unchanged (but see Evaluating 2 below).

Monitoring. Apply Le Châtelier's principle to see that the reaction proceeds in the direction that lowers the increased concentration or raises the decreased concentration.

Evaluating. (1) As you know, sulfur exists most commonly as S_8. How would this change in formula affect the answers? The balanced equation and Q_c would be:

$8H_2S_{(g)} + {}_4O_{2(g)} \rightleftharpoons S_{8(s)} + 8H_2O_{(g)}$ $\quad Q_c = \frac{[H_2O]^8}{[H_2S]^8[O_2]^4}$

The value of *K*c is different for this equation, but the changes described in the problem have the same effects. For example, in (a), if O_2 were added, the denominator of *Q*c would increase, so $Q_c < K_c$.

As above, the reaction would proceed to the right until *Q*c again. In other words, changes predicted by

Le Châtelier's principle for a given reaction are not affected by a change in the balancing coefficients.

(2) In (d), you saw that adding a solid has no effect on the concentrations of other components:

because *the **concentration** of the solid cannot change*, it does not appear in *Q*. But *the **amount** of solid can change*. Adding H_2S shifts the reaction to the right, and more S forms.

Transfering. In a study of the chemistry of glass etching, an inorganic chemist examines the reaction between sand (SiO_2) and hydrogen fluoride at a temperature above the boiling point of water: $SiO_{2(s)} + 4HF_{(g)} \rightleftharpoons SiF_{4(g)} + 2H_2O_{(g)}$

Predict the effect on $[SiF_4]$ when **(a)** $H_2O(g)$ is removed; **(b)** some liquid water is added; **(c)** HF is removed; **(d)** some sand is removed.

Sample Problem 2 (Investigation). Effect of Temperature Changes on Equilibrium

Identifying/Setting Goals

1. Being able to observe a shift in chemical equilibrium when the temperature changed.
2. Being able to use metacognition skills and solving problems related to chemical equilibrium shift.

$N_2O_4(g) \rightleftarrows 2NO_2(g)$ a H = 58 kJ

Endothermic

Selecting Strategies and Plans

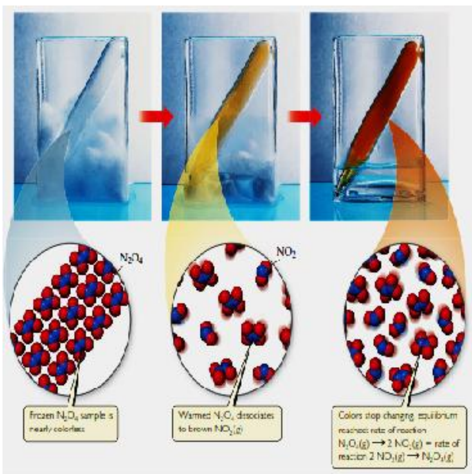
Make hypotheses, tools and materials, any variables contained in the experiment and plan your strategies!

Tools and materials

The reaction tube is sealed gas containing NO_2 three pieces, ice, glass chemistry 100 mL, burner spirits, leg three and asbestos, and thermometer.

Making Investigation (Act on Your Strategy)

Work steps: Labelling test tube with the letters A, B, and C. Fill a beaker with water and bring to a boil burner spiritus until boiling 0°C, 28°C and 100 °C. Fill a beaker with ice, and then enter the test tube A into the beaker. Note the color of the gas a test tube A and compare the color of the reaction tube B. Insert another beaker the test tube C containing NO_2 gas into a beaker of boiling water. Note the color of the gas in a test tube and compare the color of the reaction tube B Explain why the color of the gas in a



Observation Result

After conducting experiments, fill in Table 2.

Table 2 Data observations

Tube	Treatment	Observation
A	Cooled in ice (0°C)	**Colorless**
B	Room temperatur (comparison)	**Yellow**
C	Heated in water (100°C)	**Brown**

Exothermic reaction

$$2NO_2\,(g) \rightleftarrows N_2O_4\,(g)\quad aH = -58\ kJ$$

Figure 2 The equilibrium between $2NO_2\,(g) \rightleftarrows N_2O_4$ (Brown *et al.*, 2004)

Monitoring Strategy Use

1. What measures have you implemented to walk properly (in accordance with the steps trial).
2. Does the experimental results obtained in accordance with the theory/literature. Please check back or compare and explain! Perform repairs if there is a mistake!

Analyzing

1. How does the equation in these experiments
2. How does the color of the third solution in the test tube
3. What causes discoloration of the solution in a test tube first and second

Reflecting and Evaluating

1. How do your hypothesis acceptable?
2. What conclusions can be made?
3. Communicate/presented! How did the other group? And then perform a reflection on the results and processes in this experiment! What is the concept that you find difficult or not yet understood? How do I solve the problem related? Summarize your experiment and be prepared to explain it!

Transferring

Experiment using $CoCl_4.6H_2O$ solution and isopropyl alcohol. Enter each 15 mL and 15 mL $CoCl_4.6H_2O$ into three glass beaker. Mark A,B, and C. A heated solution, while the solution was cooled using an ice B. C solution is used as a comparison color. Observe and record observations.

Metacognitive questions can play an important role in making a student's learning process more efficient. For example, questions can help students to: (1) activate their preknowledge (Osman & Hannafin, 1994), (2) enhance their understanding of the task (Kramarski & Zeichner, 2001), (3) improve their cognitive processes (Kaberman & Dori, 2009), (4) use metacognitive skills (Conner, 2007), and (5) enhance metacognitive skills (Taylor et al., 2002). During a problem-solving task questions can be posed by teachers or by students themselves through self-questioning. Taylor and colleagues (2002) describe self-questioning as a procedure in which students ask themselves questions about the text they read. In the present study, metacognitive questions will be used during teacher-student conversations in order to make improvement of metacognitive skills possible.

According to above explanation, so author made scheme of the student performance activities in the i-SMART model is described Table 3 below.

Table 3 Metacognitive Questioning and Student Performance Activities (modified from Mevarech & Kramarski, 1997; Kapa, 2002; Kramarski & Mizrachi, 2004)

Metacognitive questioning or direction	Performance activity
Metacognitive support through the problem solution Identifying: What is the problem about? What is given in the problem? Representing: What are the similarities and differences between the given problem and problems you have solved in the past, and why? In what sense is this represent problems Planning: What strategy can be used in order to solve the problem? Why is this strategy most appropriate for solving the problem? Monitoring: How can the suggested plan be carried out? Evaluating: Is the solution suitable for the problem's conditions? . Reflecting: Does the solution make sense?. Is there another way to solve the problem? Transfering: Can I apply an understanding or skills to new situations?	Data coding in the 'draft page' Example' button flashes similar to the example? Representing the problem mentally (or visualization problem with a computer program and simulation). Mapping' button flashes; Clicking it offers the next phase; Solves the problem on the draft page' Try-revise-check activities. The solution check Pressing the Enter key. If the answer is 'yes', a window for writing the additional solution is opened, otherwise the next question is presented Make disscuss group or investigating to challenge problems solving are implementable.

The learning can be implemented with teachers, then proceeded with the group discussion and class discussions. For enrichment, students are given individual tasks. (1) In the group activities, students work on group worksheets, students work with a group of friends to find a solution, discussion, questions and answers among group members, and agree the final results of the work of the group. In this case the student may request assistance from the teacher if all members of the group can not find the answer. Teachers inform the background of the importance of learning, previous knowledge to remember, and give motivation to the students. (2) In the classically activities, representatives of the group presenting the results of group discussions, the others give response, then get the result of discussions. (3) At the individual activity, students work on independent worksheets, students work alone, and if students find difficulty, students can ask to the teacher, not to their friend. So i-SMART models appeared to be a useful educational tool for students. The model helps students to solve problems in a systematical way and supported scaffolding metacognitive questioning.

CONCLUSION

Using i-SMART model is an alternative solution, because the i-SMART model training supported students abilities to solve complex chemistry problems and use metacognitive skills associated with five aspect: (1) representing skills (identifying and representing problems), (2) planning skills (formulating a problem, formulate hypotheses, identify variable manipulation, response variables, and control variables, formulate an operational definition of variables), (3) monitoring skills (conducting experiments and monitor performance, the results of experiment is organizing data, perform analysis of experimental data, (4) Evaluating skills (making inferences, evaluate the effectiveness of trial strategy/problem solving), (5) Transferring skills (applying certain strategies to new situations). Using i-SMART model of learning chemistry to be very useful in developing the student's metacognitive skills through problem solving. The model helps students to solve problems in a systematical way and supported scaffolding metacognitive questioning.

REFERENCES

Bauer, R.C., Birk, J.P. & Marks, P.S. (2010). *Introduction to Chemistry: A Conceptual Approach*. 2nd Edition. New York: McGraw-Hill.

Bell, C. V. (2008). *Cultural Diversity and White Teacher Sacffolding of Student Self-Regulated Learning in Algebra Classes*. Dissertation. School of The Ohio State University.

Billing, D. (2007). Teaching for transfer of core/key skills in higher education: Cognitive skills. *Higher Education, 53,* 483-516.

Brown, T.L., Lemay, H.E., Bursten, B.E., Murphy, C.J. & Woodward, P.M., (2012). Chemistry the Central Science 12th Edition. Boston: Printice Hall.

Brown, A. L., (1987). Metacognition. Executive control, self regulation and other more mysterious mechanisms. In F. E. Weiner & R. H. Kluwe (Eds.), *metacognition, motivation, and understanding*. Hillsdale, NJ: Erlbaum.

Chandrasegaran, A. L., Treagust, D., Waldrip, B., & Chandrasegaran, A. (2009). Students¶ dilemmas in reaction stoichiometry problem solving: Deducing the li m i ti ng reagent i n chemical reactions. *Chemical Education Research and Practice, 10,* 14-23.

Conner, L.N. (2007). Cueing metacognition to improve researching and essay writing in a final year high school biology class. *Research in Science Education, 37* (1), 1-16.

Cooper, M., Sandi-Urena, G.S. & Stevens, R. (2008). Reliabel multi method assessment of metacognition use in chemistry problem solving. *Chem. Educ Res. Pract.*, 2008, **9**:18-24. www.rsc.org/cerp.

Cooper, M., & Sandi-Urena, S. (2009). Design and validation of an instrument to assess metacognitive skillfulness in chemistry problem solving. *Journal of Chemical Education*, 86, 240-245.

Corolan, J., Prain, V., & Waldrip, B. (2008). Using representations for teaching and learning in science, 54(1), 18-23.

Delvecchio, F. (2011). Students' Use of Metacognitive Skills While Problem Solving in High School Chemistry. Thesis for Master Education. Queen‟s University Kingston, Ontario, Canada

Ernest, P. (1991). *The Philosophy of Mathematics Educations.* London: Falmer Press.

Erskine, D.L., (2009*).* Effect of Prompted Reflection and Metacognitive Skill Instruction on University Freshmen's use of Metacognition. Dissertation. Department of Instructional Psychology and Technology. Brigham Young University.

Java, L.A. (2014). *Problem Solving Strategies and Metacognitive Skills for Gifted Students in Middle School*. Thesis. Philippines: Louisiana State University.

Kaberman, Z., & Dori, Y.J. (2009). Metacognition in chemical education: Question posing in the case-based computerized learning environment. *Instructional Science, 37,* 403-436.

Kapa, E. (2002). A Metacognitive Support during The Process of Problem Solving in A Computerized Environment. *Educational Studies in Mathematics* **47:** 317–336, *Netherlands:Kluwer Academic Publishers.*

Kramarski, B., & Zeichner, O. (2001). Using technology to enhance mathematical reasoning: Effects of feedback and self-regulation learning. *Educational Media International, 38*, 77-83.

Kramarski, B., and Mizrachi, N. (2004). Enhanching Mathematical Literacy with The Use of Metacognitive Guidance In Forum Discussion. *28th Conference of the International Group for the Psychology of Mathematics Education*, *3*, pp. 169-176.

Mac Gregor, D. (2007). *Developing Thinking Developing Learning: A Guide to Thinking Skill in Education.* Open University Press: McGraw Hill.

Mevarech, Z. R., & Kramarski, B. (1997). IMPROVE: A Multidimensional Method for Teaching Mathematics in Heterogeneous Classrooms. *American Education Research Journal , 34* (2), 365-394.

Moreno, R. (2010). Educational Psychology. New York: John Wiley & Sons Inc.

Osman, M.E., & Hannafin, M.J. (1994). Effects of advance questioning and prior knowledge on science learning. *Journal of Educational Research, 88* (1), 5-14.

Polya, G. (1973). *How To Solve It; A New Aspect of Mathematical Method* (2nd ed.) Second Printing. New Jersey: Princeton University Press.

Renner, J.W., Abraham, M.R., Birnie, H. H. (1988). The necessity of each phase of the learning in teaching high school physics. *Journal of Research in Science Teaching.* Vol 25(1), 39-58.

Rickey, D. & Stacy, A. M. (2000). The role of metacognition in learning chemistry. Journal of Chemical Education. Vol. 77 No. 7, pp. 915-920.

Silberberg, H.W. (2009). Chemistry, The Molecular Nature of Matter and Change Fifth Edition. New York: McGraw-Hill.

Sousa, D. A. (2012). *How the Brain Learns 4th edition*. Jakarta: PT Indeks.

Taylor, L.K., Alber, S.R., & Walker, D.W. (2002). The comparative effects of a modified self-questioning strategy and story mapping on the reading comprehension of elementary students with learning disabilities. *Journal of Behavioral Education, 11* (2), 69-87.

Tytler, R., Prain, V., Hubber, P., & Waldrip (Eds.). (2013). Constructing Representations to Learn in Science, 1-14. © 2013 Sense Publisher. All rights reserved.

Vicente, T. (2011). Macro, submicro, and symbolic: The many faces of the chemistry "Triplet" *International Journal of Science Education*. **33**, (2), pp 179-195. Routledge Taylor & Francis Group. http://www.informaworld.com/smpp/title"content=t713737283.

Whitebread, D., Coltman, P., Pasternak, D. P., Sangster, C., Grau, V., Bingham, S., Almeqdad, Q., & Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition and Learning*, *4*(1), 63-85.

The development of environment instructional media to increase the student's responsibility in elementary school of flooding problems

Masitah[1], Sonja VT Lumowa[2] , Richart Singal[3]
[1] *Education Faculty of Mulawarman University*
[2] *Education Faculty of Mulawarman University*
[2] *Education Faculty of Mulawarman University*

email: sitaeend@yahoo.co.id

ABSTRACT

The development of environment instructional media to increase the student's responsibility of flooding problems which happen in Samarinda East Kalimantan. It is necessary because of flooding is a problem that is very common in Samarinda,The Student's in Elementary School must have a responsibility early because of that it is important to development an instructional media which can make the right responsibility for this problem, in the second year of this research have the aim to know the effectivity of this media. There are two class, the first class is control and the other is experimental class with have the same ability, from the result of t - test we know that the probability of t -test is less than 0.05 it's mean that there are the difference between control class and experiment class which instructional media used. The conclusion of this research is this instructional media have the effectivity for increase the responsibility of flooding problems

Keywords: Development**,** Environment Instructional Media, Student's responsibility, flooding problems

1. PRELIMINARY

The current environmental problems increasingly complex and increasingly widespread impact. One of the example is the environmental problems related to flooding in the Samarinda city. From year to year occur as a result of the expansion of the flooded area flooding. One of the triggering factors is the loss of a sense of human responsibility towards the environment. Appropriate handler to foster a sense of environmental responsibility is through education that is carried out early that began in elementary school.

Referring to the problems that occur in learning science then the general purpose of this research is to solve problems of learning science in elementary school. Problems learning science in question is the problem of shortage of media that can be used by teachers to improve or optimize the results of learning science in elementary school. The specific objective of research in year 1 is developing a flood of media-based learning environment to the test so as to obtain a draft expert instructional media and instructional media draft I. The next process is the first draft of instructional media development of a package of media-based learning environment refers to the model of development and Cary Dick (1990), starting with stage 1) determination of the subject matter and competency standards and indicators to be achieved by students, 2) analysis of the needs, 3) the development of a package of media-based learning environment flood, 4) expert test development results 5) the test results of the development of a media package flood-based learning environment. Pilot activities that limited field trials conducted by modeling techniques so that when the implementation of the research have been skilled teacher for the operationalization of learning media in order to facilitate the learning of students in solving the problem of flooding. Limited field trials conducted in the year to the second, simultaneously measuring the effectiveness of instructional media were developed to facilitate the students' sense of responsibility to the problem of flooding in the city of Samarinda. In addition to learning media package also developed assessment creative attitudes and behavior related to a sense of responsibility towards the problem of flooding and rubric.

Another benefit is happening increase competence of the writer so that the capital of knowledge gained be equipped to develop matters related to research in an effort to increase the capacity of the study program.

2. LITERATURE REVIEW AND HYPOTHESES

Media education is very important to support the achievement of educational goals. Oemar Hamalik (2004: 194) in his theory of "Back to Nature" shows the importance of natural influences on the development of learners. According Oemar Hamalik (2004: 195) Environment (environment) as the basis for teaching is conditional factors that influence individual behavior and the factors that are important to learn.

Environment that is around us can be used as a learning resource. Environment includes: People around the school; Physical environment around the school, the remaining ingredients or not used, second-hand materials and when processed can be used as a source or a tool in learning, as well as natural events and events that occur in the community. Thus, learning media environment is an understanding of a particular symptom or behavior of the object or scientific observation of the things that are around as a student teaching before and after receiving the materials from the school by bringing experiences and discoveries with what they encounter in their environment.

3. RESEARCH METHODS

This study is divided into two stages of research. The first research and development of a second experimental research. Research

1. Development of Media-Based Learning Environment Package Flood

1.1. Methods and Data Collection Procedures

The method used for the study is the development of research methods of quantitative and qualitative research methods. Data collection procedures begins with stage 1) determination of the subject matter and competency standards to be achieved by students, 2) analysis of the needs, 3) the development of a package of media-based learning environment, 4) trial package of media-based learning environment that field trials limited implemented through modeling techniques (Azizah, 1999) so that when the implementation study teacher has the skills to implement media-based learning in the learning environment of this flood.

Pilot activities that limited field trials conducted by modeling techniques so that when the implementation of the research have been skilled teacher for the operationalization of learning media in order to facilitate the learning of students in solving the problem of flooding. Limited field trials conducted in the year to the second, simultaneously measuring the effectiveness of instructional media were developed to facilitate the students' sense of responsibility to the problem of flooding in the city of Samarinda. In addition to learning media package also developed assessment creative attitudes and behavior related to a sense of responsibility towards the problem of flooding and rubric.

1.2. Analysis

Data analysis capabilities to solve the problem of flooding after pilot activities with modeling techniques using the t test. If the results of the t test showed results that did not differ significantly between students who are taught by the writer as a model and as a teacher or TPP until the writer have successfully transformed the scenario-based learning media package flooded neighborhood. The syntax application scenario-based learning media package flooded neighborhood collected through observation sheet held by the writer analyzed qualitatively with the tabulation.

2. Research Experiments

2.1. Methods and Procedures Data collection and analysis

The method used to determine the effect (effectiveness) implementation of media-based learning environment, the same ability students beginning of the sense of responsibility of students related to the problem of flooding in the city of Samarinda, using a quasi-experimental research design with pretest posttest control group research design.

Data collection procedure is done through pre-test and post-test techniques. Pre-test is conducted by students to solve the problem of flooding which was held on the same ability students before the learning activities with media-based learning environment. Pos tests carried out in a way students solve flooding problems after learning with media-based learning environment flood. In an attempt to apply the authentic assessment its only assessment, carried out through the matter but comes with observations through observation sheets and the ability of students working on solving problems related to the presentation of the concept of science in everyday life. Data analysis techniques with descriptive analysis, statistical analysis t test

4. RESULTS AND DISCUSSION

A. Research

This study aims to determine the effectiveness of the use of media-based learning environment by using a quasi-experimental research design and with pretest posttest control group design. Wherein the control class and experimental class have the same initial ability and the data is homogeneous.

Table 1. t Test Results

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig	t	df	Sig.
Equal variances assumed	.238	.628	-14.426	64	.000
Equal variances not assumed			-14.426	63.182	.000

Based on the table above shows that F count has a probability value> 0.05 then the two variances are homogenous variance. While the t test obtained from the above calculation is the value of probability t <0.05 means that there is a difference between control and experimental group classes. Or in other words there are differences in measurement results elementary school students' sense of responsibility towards the problem of flooding by using instructional media used.

In this study also developed an evaluation rubric realm of attitudes (affective) and behaviour creative in order to measure the students' sense of responsibility associated with flooding problems.

B. Discussion

In the classroom learning process control carried out by the media that has been owned by the teacher in accordance with the book used by teachers in their daily life.

The learning process includes initial activities by motivation and delivery of learning objectives, core activities performed by the delivery of content is done by lectures and question and answer and discussion, to cover activities carried out the evaluation and conclusion.

The experimental class learning process implemented by using media-based learning environments have been developed, starting from the initial activities on the first activities already use the media through the displayed image on the flood situation in the city of Samarinda, followed by core activities are carried out through a brief explanation by the teacher with media-based learning environment has been developed, after the group discussion, presentation, and discussion, ending with the closing.

Instructional media are materials, tools, and methods / techniques used in teaching and learning activities with the intention that the process of interaction of educational communication between teachers and students can take place effectively and efficiently in accordance with the purpose of teaching that have aspired. On improving the students' sense of responsibility in the problem of flooding in the city of Samarinda, it is clear that by using media-based learning environment that is the student's ability to analyze and understanding regarding flooding problems more can be achieved to the fullest.

Measurement sense of responsibility can be seen from the evaluation of creative attitudes and behavior are given, which in this evaluation reflects how the students' sense of responsibility towards the problem of flooding with the real conditions seen in their neighborhood, a good school environment or neighborhood.

The importance of the selection of instructional media that exist for the achievement of a goal of learning this more clearly demonstrated that the selected medium must be a medium that can be understood by learners, using a real example in the environment can be to make learners increase understanding of the subject matter, otherwise it is not only the cognitive learning that can level with a good selection of media, but the results affective (attitude) as well as the creative behavior of students can be measured well, such evaluation have been developed in this research.

5. Conclusion

Based on the research that has been achieved up to this progress report is made can be summarized as follows:

There are differences in the results of elementary students a sense of responsibility towards the problem of flooding by using media-based learning environment that has been used, which is derived from the analysis of data using the t test, where the probability value of $t < 0.05$

Sense of responsibility can be measured with the use of evaluation realm of attitudes (affective) and behaviors that have developed creative.

2 REFERENCES

Anderson and Krathwohl. 2001. *A Taxonomy for Learning, Teaching, and Assessing A revision of Bloom's Taxonomy of Educational Objectives.* New York: Addison Wesley Longman, Inc

Anonim.ekhos.wordpress.com/…/lingkungan-sebagai-sumber-dan-media-pembelajaran/ diakses 23 Maret 2012

Anonim.susantotutor.wordpress.com/…/barang-bekas-dan-barang-sederhana-sebagai-media-pembelajaran

Aristo. 2008. *Pemanfaatan Lingkungan sebagai Sumber Belajar*. Http://aristohadi.wordpress.com/2008/05/17/pemanfaatan-lingkungan-sebagai-sumber-belajar/

Azhar, A. 2006. *Media pembelajaran*. Jakarta: PT. Raja Grafindo Persada

Azizah, U. 1999. Efektivitas Modeling Sebagai Strategi Pelatihan Guru dalam Menerapkan Model Pembelajaran Kooperatif. *Media Pendidikan dan Ilmu Pengetahuan.* 22 (4). Hlm. 191-212.

Dick, W. and Cary Lou. 1990. *The Systematic Design of Instruction.* 3rd Ed. New York: Harper Collins Publisher.

Duch, BJ: Allen D.E., and White, H,B. 2002. Problem Based Learning; Preparing Student to Succeed in the 21 Century, http://www.pondnetwork.org- Dakses 9 Maret 2013

Hart, D. 1994. *Authentic Assesment A Handbook for Educators.* California, New York: AddisonWesley Publishing Company.

Ibrahim, M dan Nur , M. 2000. Pengajaran Berdasarkan Masalah, Surabaya: Unesa University Press

Ibrahim, M. 2002. *Assesmen Autentik (Authentic Assesment) dan Contoh-contoh dalam Biologi.* A reference used in the fellowshp Program Contextual Learning Materials Development Proyek Peningkatan Mutu SLTP Jakarta Batch II, 2 to 27 Pebuari 2002. Direktorat Sekolah Lanjutan Tingkat Pertama Dirjen Dikdasmen Depdiknas in collaboration whit University of Washington College of Education,

Liliasari. 2001. Model Pembelajaran IPA untuk Meningkatkan Keterampilan Berpikir Tingkat Tinggi Calon Guru sebagai Kecenderungan Baru pada Era Globalisasi. *Jurnal Pengajaran MIPA. 2(1).* Hlm. 55-56.

Lord, T.R. 2001. 101 Reasons for Using Cooperative Learning in Biology Teaching. *The American Biology Teacher.* 63 (1). p. 67-75

Moenfarida, D. 2011. LINGKUNGAN SEBAGAI MEDIA PEMBELAJARAN. http://variedzzz.wordpress.com/2011/05/10/lingkungan-sebagai-media-pembelajaran/. Diakses 17 Maret 2012

Nana, S. 1997. *Media pengajaran penggunaan dan pembuatannya*. Bandung: Sinar baru

Ommundsen,P.2001. Problem Based Learning in Biology, whith 20 Case Examples,http://searchyahoo.com/search?p-problem+based+leaming. Diakses 9 Maret 2007

Suharsimi, A. 2002. *Prosedur Penelitian*. Jakarta: Rineka Cipta

Tindangen, M. 2006. Implementasi Pembelajaran Kontekstual Peta Konsep Biologi Siswa SMP Berkemampuan Awal Berbeda Serta Pengaruhnya Terhadap

Kemampuan Berpikir Tingkat Tinggi dan Hasil Belajar Kognitif. Disertasi tidak diterbitkan. Program Pasca Sarjana Universitas Negeri Malang.

Tuckman, B.W. 1999. *Conducting Educational Research. 5*th Ed. New York: Harcourt Brace College Publishers.

Winami, E. 2006. Pengaruh Strategi Pembelajaran terhadap Pemahaman Konsep IPA, Kemampuan Berpikir Kritis, dan Sikap Imiah Siswa dengan dengan Tingkat Kemampuan Akademik Berbeda. Disertasi tidak diterbitkan. Program Pasca Sarjana Universitas Negeri Malang.

Wirasunu, T. 2002. *Statistik dalam Penelitian Psikologi dan Pendidikan.* Malang: Penerbit Universitas Muhammaddiyah Malang.

The Product of this research

Problem Evaluation
Hint Charging Problem:
Look closely at the picture below!
Answer the questions listed properly!

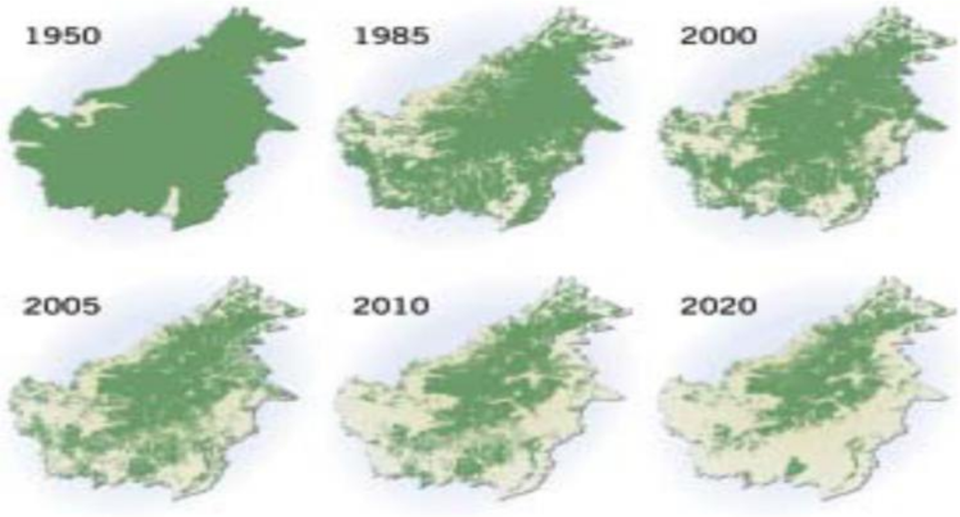


Figure 1. Kalimantan Forest Cover 1950-2020

Note Figure 1 above!

1. What is shown in the picture above?
2. Why such a thing can happen in the picture above?
3. How the image linkage with the floods that occurred in the city of Samarinda!
4. After seeing this effort what you can do around your place so that the condition of forests can be back as in 1950?
5. Make the questions related to the image!

Problem Evaluation
Hint Charging Problem:

1. Look closely at the picture below!
2. Answer the questions listed properly!

Figure 2. Piles of garbage in Waterways

Note Figure 2 above!

1. What is shown in the picture above?
2. Why did it happen?
3. What are the consequences if this trend continues as it did in the picture above?
4. Who is affected if this happens?
5. Are around where you live there is something like that shown in the picture?
6. What links these images with the floods in Samarinda?
7. Make the questions related to the image above!

Problem Evaluation

Hint Charging Problem:

1. Look closely at the picture below!
2. Answer the questions listed properly!

Figure 3. Oil Palm Plantation

Note Figure 3 above!
1. What is shown in the picture above?
2. Why such a thing can happen in the picture above?
3. How the image linkage with the floods that occurred in the city of Samarinda!
4. After seeing this effort what you can do to prevent it so it can not happen?
5. What is the danger if forest clearing continue to be done?
6. Make the questions related to the image above!

Problem Evaluation
Hint Charging Problem:
Look closely at the picture below!
Answer the questions listed properly!

Figure 4. Forest Clearance for Settlement Region in Samarinda

Note Figure 4 above!

1. What is shown in the picture above?
2. Why such a thing can happen in the picture above?
3. How the image linkage with the floods that occurred in the city of Samarinda!
4. After seeing this effort what you can do to prevent it so it can not happen?
5. How many of your brother?
6. What is the danger if forest clearing continue to be done?
7. Make the questions related to the image above!

Problem Evaluation

Hint Charging Problem:

1. Look closely at the picture below!
2. Answer the questions listed properly!

Figure 5. Condition After Discontinued Mining Activities

See Figure 5 above!

1. What is shown in the picture above?
2. Why such a thing can happen in the picture above?
3. How the image linkage with the floods that occurred in the city of Samarinda!
4. After seeing this effort what you can do to prevent it so it can not happen?
5. What is the danger if forest clearing continue to be done?
6. Make the questions related to the image above!

ANALYSIS OF USING CHEMICAL LABORATORY IN SMA STATE EAST KALIMANTAN

Muh. Amir M

ABSTRACT

The aims of this research is to described the use of instructional media and chemical laboratory chemistry on high school students in East Kalimantan. The method that used in this research is a qualitative approach because it used the data source directly as a scientific background. The subject of this study are; 1) the principal, 2) vice curriculum 3) teachers 4) students, who knowed and can be trusted to be the source of the data and determine the depth of the problems study. The source of the data is the Education Unit Level High School in East Kalimantan. The resulted of laboratory research to the design aspects related with layout, number and arrangement of space inside the laboratory has good criteria with the percentage is 74.39%. Administrative aspects indicated have obstacles in that and this is in accordance to the results of interviews and direct observation, with percentage is 66.30%. Lab administration has good enough criteria differently with other aspects that reached a percentage is over 70%. Practical aspects of the management in the provision related is how the course of events before and after the practicum takes place based on the supporting data reached a percentage is 79.94%. From this percentage showed that practicum implementation has been very ready. Completed aspects of tools and materials, which reached up to 90% with very good prepared of criteria, it is in accordance with the observational data that showed the tool and the material in the chemical laboratory has been standardized school laboraotrium. Thus, the implementation of the learning process average teacher in every teaching chemistry using the media as a supported of teaching and learning so that students are very enthusiastic, especially increasing the activity and motivation during the lesson.

Keywords: Analysis, Laboratory chemical, Senior High School

Introduction

Chemical subject in senior high school, especially chemistry, for the subject matter or specific example: colligative properties, acid-base, electrolyte solution and other electrolysis tend to value the students did not change satisfactory. This cases occur because the materials requires cognitive understanding with high levels of analysis. We need the correct solution for facilitate the understanding of students who require level of analysis and abstract. The correct solution is using the media and make learning laboratory so it can be more innovative, attractive and students can follow and digest the lessons with fun.

In understanding the subject matter, students need four pillars, namely: knowledge, skills, independence and the ability to adaptation and cooperation. Knowledge retrieved students from learning resources is teachers. Being a teacher must be creative with making skillful using the media in teaching and learning process. Thus, the learning experience in observing and interacting with a variety of media that matches the topic be taught. Skill pillar, self-reliance and cooperation in chemistry learning, especially topics that need a high level of understanding and the abstract can be understand by using the appropriate method or experiment method in the laboratory, so students directly practice guided by a teacher or a laboratory that has been designated before. With laboratory experiments through the practice can make students more motivated, attractived, and skilled as well as getting cooperation among students directly. So that students get a better learning experience with improved learning outcomes than before.

Methods

The approach that used in this research by type of data, this study includes qualitative research. All of the characteristics variables examined in this study was described without any treatment or control in particular, also maintained the unity in order to learn about the objects and subject as an integrated whole.

Research procedure

Research procedure includes the following phases :

a. Preparation phase: observation to school, analyze the material to be taught, preparation for the lesson in the form of RPP, determine instructional media in accordance with the material, and create research instruments that will be used during the study.
b. The implementation phase: setting up a class that will be used, carry out learning by using media that has been determined, and conducting test at the end of the meeting.
c. The final phase: analyze and process data from the study, conclude observations.

Data Collection Procedures

The data collection process began with an interview followed by observation, documentation study and returned with in-depth interviews. Nevertheless, on several occasions in the third field, data collection techniques were used simultaneously. Data collection techniques in this study is the cover interview, observation and documentation. The technique was used in this study, because the phenomenon qualitative research can understand, when do interaction with the subject by means of depth interviews and observed on the background, where the phenomenon takes place. In addition, to complete the data need documentation.

Analysis Data

Data analysis technique that used in this research is the analysis of qualitative data, following the concept given Miles and Heberman in Sugiyono (2005) which suggests that activity in qualitative data analysis is doing an interactive and takes place continuously at every phase of this research until complete and saturated. Activity in data analysis of the data reduction, a data display and conclusion drawing/verification.

Research result

The behavior of the students to find and get new information is highly, passion for sharing knowledge among friends, especially the group also looks shown by the students, is a manifestation of the ability to become peer tutors were revealed during a discussion among the students to determine the structure of a compound view using wax media. Preparation laboratory, teacher and laboratory assistant supported the implementation of the curriculum, such as expression of laboratory assistant "It can be support in accordance with the curriculum, the first chemical more compute but now more experiments though simple. "Its main activity raises a child's interest in learning chemistry experiment although it simple"

Table 1 .. Criteria and Percentage Preparation Design Chemistry Laboratory Facilities

No	Preparation Criteria	Preparation Percentage	Average Percentage	Percentage Interval	Preparation Percentage
1.	Public Facilities	86,81 %	74,39%	50% - 74,9%	quite ready
2.	Special Facilities	66,57%			
3.	Additional Facilities	69,79%			

Table 2. Percentage Preparation Chemistry Laboratory Administration at Senior High School

No	Criteria Preparation	Preparation Percentage	Average Percentage	Percentage Interval	Percentage Preparation
1.	Organizer of laboratory	59,38%	66,30%	50 % - 74,9%	quite ready
2.	Discipline of laboratories	72,40%			
3.	Administration tools and materials	67,13%			

Table 3. Percentage Preparation Management Providing Practical Aspects Chemical at Senior High School

No	Preparation Criteria	Preparation percentage	Average percentage	Interval percentage	Preparation Criteria
1.	Planning the practicum	75,54%	79,94%	75% - 100%	quite ready
2.	Implementation of the practicum	91,67%			
3.	Evaluation practicum	73,61%			

Table 4. Percentage Completeness of tools and materials in Laborarotorium Chemical at Senior High School

No	Preparation Criteria	Preparation Percentage	Average Percentage	Percentage Interval	Preparation Criteria
1.	Preparation tools	87%	90%	75% - 100%	Very prepared
2.	Preparation material	93%			

In order to the learning can good work, the teacher has prepared all devices, check the availability of tools and materials as well as testing before students try. Practical implementation need to be prepared to provide pre-test and post-test so that students understand and easy for do practicum.

Discussion

Curriculum implementation in 2013 can not be separated from the curriculum KTSP. So that, when there are changes in the curriculum, the implementation was initially still combined the previous curriculum, then added or enhanced with the latest curriculum. For practical implementation has always strived to be done, even though the curriculum in 2013 a new curriculum but for practical activities can customize the material so that the lab can still be accomplished.

All laboratories should be designed to facilitate experimental work and reduce accidents. All employees are trained to understand the capabilities and limitations of ventilation systems, environmental control, laboratory hoods, and other exhaust devices and how to use them properly. The experimental work should be seen as part of the laboratory and facilities, both for safety and efficiency issues

Laboratory SMAN 1, 2 Samarinda and SMA 1, 2 and 4 Berau of facilities is sufficient if it refers to the Permendiknas No. 24 of 2007, it is supported with good assistance from the central, provincial and local levels. So that in the utilization of the laboratory has been able to support the implementation of the mandated curriculum. Limitations of the tool or material demands more creative teacher to look for tools or substitute materials, so that students can still explore. For practical activities is not only done in school but also outside school, created in group work and then the experimental results they are brought to school one example the electrical conductivity of the material. For practical activities outside of school has been conducted in SMAN.

Based on the average yield of 77.66% preparation criteria included in the criteria very well prepared (Widoyoko, 2013), from the data and associated data from interviews and direct observation of the implementation of the curriculum in this case related to practical activities has been running well. For laboratory design aspects related to the layout, number and arrangement of space inside the laboratory criteria quite well with the percentage of 74.39%. Administrative aspects indicate if you have obstacles in it and this is in accordance with the results of interviews and direct observation, a percentage of 66.30% lab administration with different criteria well enough with other aspects that reach a percentage of over 70%. Practical aspects of the management of the provision relating how the course of events before and after the practicum takes place based on the supporting data reaches a percentage of 79.94% of this percentage shows if the practicum in its implementation has been very ready. Aspects completeness of tools and materials, which reached 90% with the criteria very well prepared, it is in accordance with the observational data that shows if the tool and the material in the chemical laboratory has standardized school laboraotrium. Aspects preparation SMAN laboratory showing that the study sample was quite prepared to carry out the study, and of course the support of the main aspects is the creativity of teachers in teaching. The ability of the teacher to make students discover new things in each learning activity.

During the research activities taking place, based on direct observation, documentation and interviews that the main obstacles are some schools that laboratory space is insufficient, so that there are tools and materials that are still stored in the box because there is no warehouse space, malfunction of fume hoods that are stored in a glass cabinet material and molar mixed. The absence of specialized technicians is also an obstacle that defective tools are not repaired for example, scales and fume hood except a tool that can be brought into service. So that the utilization of laboratory space for the lab to be less optimal.

Conclusion

Preparation c

hemistry laboratory to support the learning process in terms of four aspects: design, administration, and management aspects of the implementation of aspects of the completeness of the equipment and materials in the criteria very well prepared. Laboratory utilization in practical activities to support the implementation of the curriculum 2013 and SBC based on interviews and direct observation has been running well.

BIBLIOGRAPHY

Arikunto S 2006, *Procedure Research: A Practical Approach*, cet. 13, Rineka Cipta, Jakarta.

LM compassion, Muderman IW, Karyasa IW, IW Karyasa, *Standard Analysis Laboratory of Chemistry and Efektivitanya Against Adaptive Competency Achievement In SMK Negeri 2* , Journal of Post Graduate Ganesha, vol. .

Hofstein A and Naaman R.M, 2007, *the laboratory in science education* : the state of the art. Journal the royal society of chemistry, 8. (2), 105-107.

Hofstein A and Vincent N L, 2003, *The laboratory in science education :* foundations for the twnty-first century.

Miles M. B and Huberman M.A, 1984, *Qualitative Data Analysis; A Sourccebook of New Methods*, Sage Publications, Beverly Hills, London.

Sitorus, M. and Sutiani, A., 2013, *the Laboratory of Chemical: management and management, issue 1*, Graha Science, Yogyakarta.

Sugiyono, 2013, *the Qualitative Research Methodology*, cet. 8, Alfabeta, Bandung

Widoyoko EP, 2013, *The Drafting Engineering Research Instruments*, cet. 2, Student Library, Yogyakarta.

SYNTHESIS CHITOSAN-ETHYLENE DIAMINE TETRA CETATE CHELATING RESIN ISOLATED FROM WINDU SHRIMP'S (*Penaeus monodon*) SHELL WASTE

Marvin Horale, Aman Sentosa Panggabean*
Department of Chemistry, University of Mulawarman, Indonesia-75119

*amanspanggabean@yahoo.com

ABSTRACT

A research on the utilization of shrimp shell waste are abundant in the province of East Kalimantan as the source of chitosan and synthesis of the derivative chelating chitosan-ethylene diamine tetra acetate (EDTA) resin and the retention of characterization for Cu(II) ions has been carried out. Chitin were obtained from Windu Shrimp's (*Penaeus monodon*) shell through three ways, are deproteination, demineralitation and depigmentation. The obtained chitin were deacetylated with sodium hydroxide at temperature 150-160˚C during 1 hour to obtained chitosan, with contain was 64.4%. Synthesis chitosan-EDTA resin can be done by coupling reacts between diazonium ion from diazotation chitosan with EDTA at temperature 1-3˚C during 1 hour, the product of 70% yield was obtained. The Chitosan-EDTA resin was synthesized has characterization by using FT-IR spectroscopic and scanning electron microscope, shows the spesific functional groups of the resin.

Keywords: Windu shrimp shell, Chitosan, Chelating resin, EDTA.

INTRODUCTION

Province of East Kalimantan is a maritime region that is rich in fishery products. One of these is the shrimp fishery products whose shell is a potential raw material for chitin and chitosan. Utilization of shrimp generally is limited for food purpose, usually meats are taken while the skin is discarded and not processed to the maximum, whereas shrimp shell contains 15-20% chitin compound.

Chitin is the second biopolymers after cellulose is abundant in the earth, the annual production in aquatic environments are estimated 10^6-10^8 tons (Cauchi, 2002). Chitin is a molecule with a large molecular weight, composed of units of N-acetylglucosamine that binds to protein with strong covalent glycoside bond (Brine et al, 1991; Roberts, 1992; Chang and Tsai, 1997).

The use of chitin is limited by its properties that are not soluble in water and difficult to separate with other ingredients-bound, especially protein, so for the utilization of chitin need to be changed first into chitosan. Chitin and chitosan in developed countries has been produced commercially since its benefits in various industries, such as pharmacy, biochemistry, biotechnology, cosmetic, biomedical, paper industry, food industry, textile industry, and others. Utilization is based on its properties that can be used as emulsifiers, coagulation, chelating, and thickening emulsion (Muzarelli, 1984).

Chitosan can be synthesized with deacetylation reaction by removal acetyl group ($COCH_3$) from chitin using alkali solution (Dutta et al, 2004). Pure chitosan is generally used as an absorbent for heavy metals in flakes and powder form. Adsorption ability of chitosan against heavy metals is strongly influenced by physical-chemical properties of chitosan. Chitosan which not cross-linked have an adsorption capacity is greater than the cross-linked chitosan, but the cross-linked chitosan have the physical endurance to acid better than not cross-linked chitosan (Wan Ngah, 2002). In recent years, the synthesis of chitosan have been carried out and modification of chitosan with the addition of side groups with the aim to analytical using such chelating resin against heavy metals contained in natural samples in trace concentrations (Katarina et al., 2005) .

Based on above description the researcher is interested to synthesize chitosan modified with the addition of ethylene diamine tetra acetate (EDTA) compound which expected to be used as a resin for retention heavy metal ion. Chitosan obtained from chitin by deacetylation reaction from windu shrimp's (*Penaeus monodon*) shells with 60 % sodium hydroxide, and then EDTA group is added as a chelating group to increase the retention capacity of resin.

EXPERIMENTAL

Instrumentation. A set of reflux system, three-neck flask, blender, sieve size of 100 mesh, filter paper, analytical balance, porcelain bowls, glass funnel, the volume pipettes, stopwatch, oven, hot plate with stirer, Spectrophotometer FT-IR (Fourier Transform-Infra Red) Prestige 21-D., Scanning electron microscope (SEM), was used for all measurements.

Reagents. All reagents were of analytical-reagent grade; sodium hydroxide, hydrochloric acid, sulfuric acid, calcium hypochlorite, acetic acid, ethanol, sodium nitrite, disodium ethylenediaminetetraacetate, and windu shrimp's (*Penaeus monodon*) shells

Sample Preparation

Windu shrimp's (*Penaeus monodon*) shells washed with destillated water, then dried . Shrimp's shell blender and sieved to obtain powder with size ≥ 100 mesh (Junaidi et al., 2009).

Isolation of Chitin

Deproteination Phase

100 g shrimp shells powder ≥ 100 mesh is added to 500 mL 3.5% NaOH ($^{w}/_{v}$). Samples stirred on heating or refluxing for 1 h at 65 ^{o}C, performed the separation between the residue and filtrate by filtration. The residue was washed with destillated water until pH neutral, and then dried in oven at 60^{o}C. Obtained raw chitin (Srijanto et al., 2006).

Demineralization Phase

Deproteinated chitin then added to 1N HCl with a ratio of 1:10 ($^{w}/_{v}$). Stirred for 3 h at room temperature, performed the separation between the residue and filtrate. The residue was washed with destillated water until pH neutral, and then dried in oven at 60 ^{o}C. Weigh free residues of protein and minerals.

Depigmentation Phase

Demineralizated chitin bleached with calcium hypochlorite 4% [$Ca(OCl)_2$] ($^{w}/_{v}$) with a ratio of 1:10 ($^{w}/_{v}$) for 1 h at room temperature, then the residue was washed with distilled water until pH neutral and dried with oven at 60 ^{o}C. Weigh obtained chitin (Junaidi et al., 2009).

Deacetylation Chitin

5 g chitin were mixed with 100 mL 60% NaOH, The mixture was then stirred on heating at 150-160 ^{o}C for 1 h. The residue was then washed until neutral pH and dried in oven at 60^{o}C. Weigh obtained chitosan. Some end products of chitosan tested to ensure solubility in destillated water, 1% CH_3COOH ($^{v}/_{v}$), 1 M NaOH, 1 M HCl and 1 M H_2SO4 (Nakano et al., 2004)

Analysis of Functional Groups and the Determination of Chitin and Chitosan Deacetylation Degree

Funtional groups and degree of deacetylation of chitosan determined using infrared spectroscopy approach. To determine the degree of deacetylation using the *base line* method of chitin and chitosan powder was analyzed within pellets form of with KBR 1%. Pellets were analyzed the groups absorption in the range of wave numbers 4000 cm^{-1} up to 400 cm^{-1}.

Measurement of absorbance value at the peak related to the degree of N-deacetylation calculated by the formula: (Srijianto et al., 2006)

$$\%\text{N - deacetylation} = 1 - \left[\frac{A_{1655}}{A_{3450}} \times \frac{1}{1{,}33} \right] \times 100\%$$

Synthesis of Chitosan - Ethylenediaminetetraacetate Resin

2 g of chitosan added to 100 mL 1M HCl alternating with addition of 75 mL 1M $NaNO_2$ until resin was azotated in the presence of iodine paper color change, by keeping the temperature between 1-3 ^{o}C. Then add dropwise 100 mL 10% EDTA and stirred for 1 h with temperature between 1-3 ^{o}C and left for 24 h in the refrigerator. The mixture was then filtered and rinsed with destillated water until pH neutral and dried in oven at 60^{o}C (Amran et al., 2010)

RESULTS AND DISCUSSION

Isolation of Chitin from Windu Shrimp's Shell

Isolation of chitin from windu shrimp's (Panaeus monodon) shell is done in 3 phases are: **(1)**. Deproteination phase, with NaOH 3.5%, the resulting yield was 35.56 % **(2)**. Demineralization phase, with HCl 1 N, the resulting yield was 66.11% **(3)**. Depigmentation phase, with 4% $Ca(OCl)_2$, the resulting yield was 58.99% or 13.87% from the weight of shrimp shell samples.

Chitin compounds were analyzed by FT-IR spectrophotometer is shown in **Figure 1**.

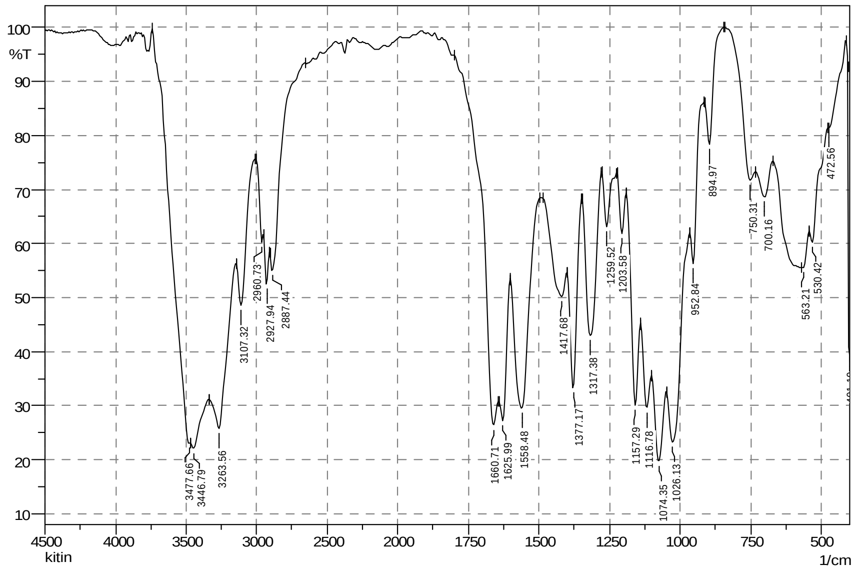


Figure 1. FT-IR spectra Chitin

The result of FT-IR spectroscopic analysis of chitin (**Figure. 1**) showed absorption peaks at the wave number (cm^{-1}): 3477.66 and 3446.79 indicate typical absorption peak of OH stretching vibration. Absorption in the wave number (cm^{-1}): 2927.94 and 2887.44 which indicates typical absorption peak of C-H sp^3 stretching vibration coupled with C-H sp^3 bending vibration on wave number (cm^{-1}): 1417.68. Absorption in the wave number (cm^{-1}): 1660.71 indicates typical absorption of stretching vibrations of carbonyl group (C=O) of acetamide ($-NHCOCH_3$). Absorption in the wave number (cm^{-1}): 1157.29 indicate typical absorption peak of C-O stretching vibrations (Junaidi, et al, 2009).

Spectra indicates vibration peaks at the wave number (cm^{-1}): 1558.48 and 1317.38 is the vibration of-NH bending and C-N streching vibrations of the acetamide group. Absorption in the wave number (cm^{-1}): 1026.13 indicate typical of the symmetrical stretching vibration of C-O-C. Vibration peak of N-H stretching in FT-IR chitin is not shown due to overlap with peak of OH stretching vibration (Silverstein, et al, 1986), because nitrogen is less electronegative than oxygen, the hydrogen bonding of the amines are weaker than in the alcohol and the frequency shift is less real than in alcohol, causes the peak of O-H stretching vibrations appear more dominant.

Determination of the Deacetylation Degree of Chitin

The deacetylation degree is a quality parameter of chitosan that indicates the percentage of acetyl groups which can be removed from the yield of chitin and chitosan. The deacetylation degree can be determined using the base line method in the IR spectrum of Chitin.The amount of deacetylation degree of chitin obtained from the comparison between the absorbance at $v = 1660.71\ cm^{-1}$ (absorption of amide I, A = 0.5796) with absorbance at $v = 3446.79\ cm^{-1}$ (absorption of hydroxyl groups, A = 0.6566). Provided the degree of deacetylation of chitin was 33.63%.

Synthesis of Chitosan

Chitosan synthesized from chitin by deacetylation process. Deacetylation is a removal process of acetyl group ($COCH_3$) from chitin using alkali solution. In this process the isolated chitin was treated with 60% NaOH at 150-160 °C for ± 1 h. Chitosan is produced after deacetylation process is yellow. Obatained rendement chitosan was 64.4%.

Obtained chitosan products was solubility tested in destillated water, of 1% CH_3COOH solution, NaOH, HCl and 1M H_2SO_4. The results showed that chitosan is only soluble in CH_3COOH solution, while in destillated water and NaOH, HCl and 1M H_2SO_4 chitosan doesn't dissolve. The characteristic of chitosan is only soluble in dilute acetic acid, this is due to the carboxyl group of acetic acid to facilitate dissolution of chitosan due to hydrogen interaction between carboxyl groups with amine groups of chitosan (Dunn, et al, 1997).

Chitosan compounds were analyzed by FT-IR spectrophotometer shown in **Figure 2**.

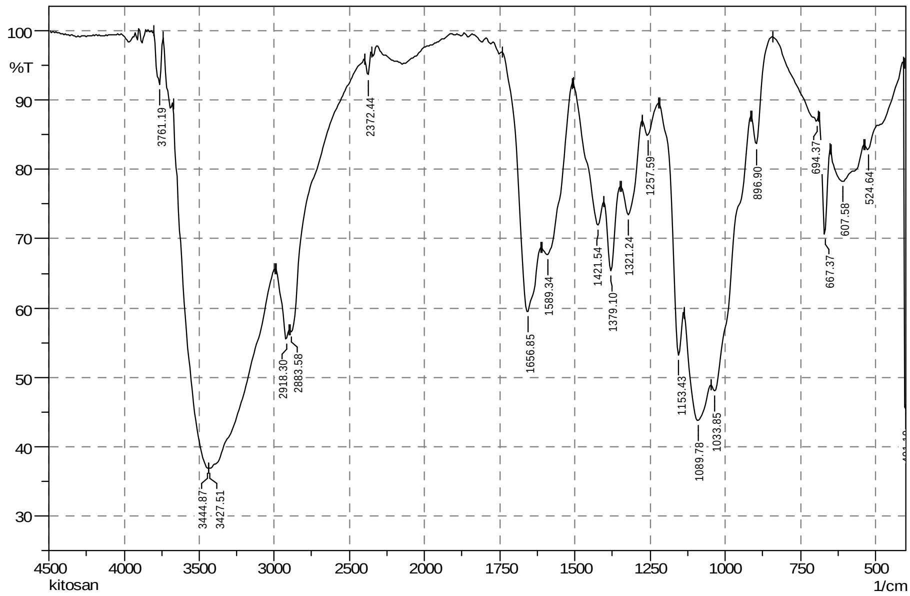


Figure 2. FT-IR spectra of Chitosan

The result of FT-IR spectroscopic analysis of chitosan **(Figure 2.**) showed absorption peaks at the wave number (cm-1): 3444.87 and 3427.51 indicates typical absorption peak of O-H stretching vibration. Absorption in the wave number (cm^{-1}): 2918.94 and 2883.58 indicates typical absorption peak of C-H sp^3 stretching vibration coupled with C-H sp^3 bending vibration of on wave number (cm^{-1}): 1421.54. Absorption in the wave number (cm^{-1}): 1656.85 indicate typical absorption of stretching vibrations of carbonyl group (C=O) as amide I absorption bands. Spectra showing vibration peaks at the wave number (cm^{-1}): 1589.85 indicate the N-H bending vibration. Absorption in the wave number (cm^{-1}): 1321.24 indicate typical absorption stretching vibration of C-N. Absorption in the wave number (cm^{-1}): 1033.85 indicate typical absorption of C-OH stretching vibrations (Huang, et al, 2009).

IR spectra of chitosan when compared with IR spectra of chitin is observed a few differences, are: loss of absorption at wave numbers 3263.56 cm^{-1}, 3107.32 cm^{-1}, 1558.48 and 1625.99 cm^{-1} and absorption at number wave 1317.38 which indicates the process of deacetylation. The appearance of absorption bands at wavenumber region 1589.85 cm^{-1} is due to the bending vibration of N-H of R-NH_2, indicates the increasing degree of deacetylation.

N-H stretching vibration peak in the FT-IR chitin isnt seen due to overlap with peak of the O-H stretching vibration (Silverstein, et al, 1986).

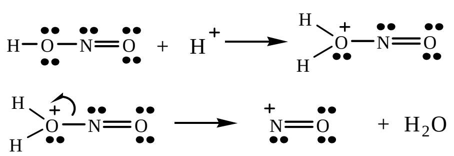
Determination of the Deacetylation Degree of Chitosan

Higher deacetylation degree of chitosan, the acetyl group of chitosan is lower so that the interaction between the ions and the hydrogen bonding stronger (Knorr, 1991). The release of acetyl group of chitosan causes the positively charged chitosan is able to bind negatively charged compounds such as proteins, anionic polysaccharides to form neutral ion. Deacetylation degree of chitosan obatained was 60.75 %.

Synthesis of Chitosan-Ethylenediaminetetraacetate Resin

Synthesis of chitosan-ethylenediaminetetraacetate resin is done through the diazotation process. Diazotation is a way to change the amine group into a diazo group using concentrated acid solution (Amran, et al, 2010). In this process chitosan reacted with 1M HCl and 1M $NaNO_2$ alternately at 1-3 ° C until the resin azotated. Reaction temperature is maintained at below 3 ^oC because the reaction is highly exothermic. Hydrochloric acid is a strong acid which serves as a catalyst and forming chitosan chloride salt. $NaNO_2$ serves as forming nitrosonium ion together with HCl (Sykes, 1989) to produce diazonium salt. The mixture then reacted with 10% EDTA dropwise and stirred for ± 1 h at 1-3 ^oC. Diazonium salt is stable at low temperature (0-4 ^oC) and sensitive to light and can easily be damaged at ultraviolet wavelength and visible light (Amran, et al, 2010). Diazonium salt has coupling reaction with ethylenediaminetetraacetate to produce chitosan-ethylenediaminetetraacetate compound. The obtained Chitosan-ethylenediaminetetraacetate resin after diazotation is white. The obtained rendement was 70%.

The diazotasi reaction is as follows at
Figure 3.



Ion Nitrosonium

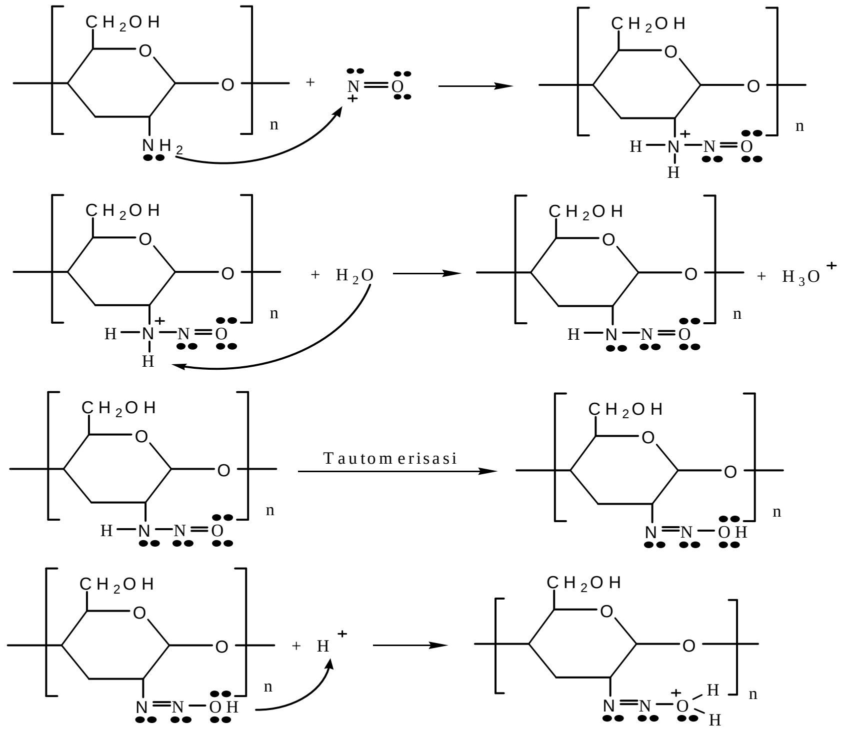
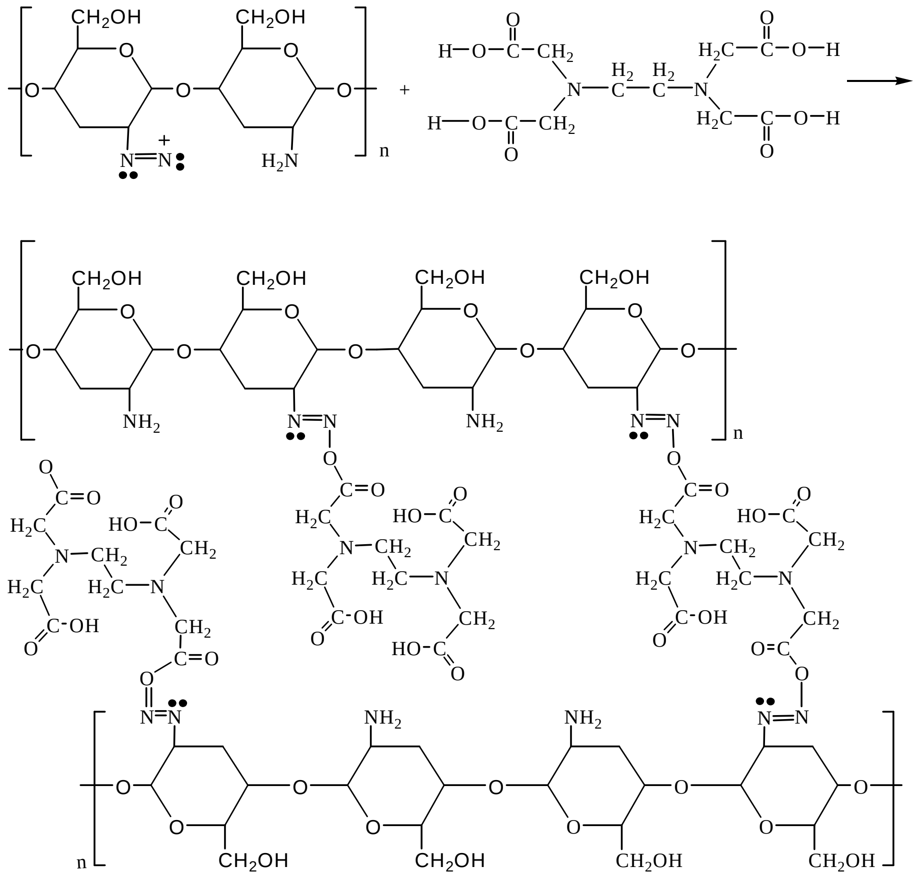


Figure 3. Diazotation Reaction Mechanism of Chitosan

The possibility of coupling reaction of diazonium salts with ethylenediaminetetraacetate at **Figure 4**.



Resin kitosan-EDTA

Figure 4. Coupling Reaction Mechanism of Chitosan-EDTA

Chitosan-ethylenediaminetetraacetate compounds were analyzed by FT-IR spectrophotometer is shown in **Figure 5**.

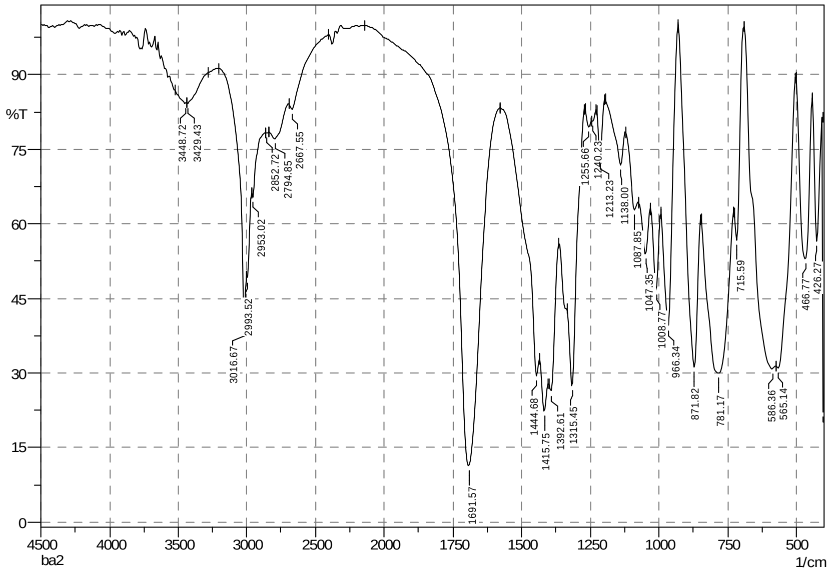


Figure 5. FT-IR spectra of Chitosan- Ethylenediaminetetraacetate

The result of FT-IR spectroscopic analysis of chitosan-EDTA show absorption peaks at wave number (cm^{-1}): 3448.72 and 3429.43 indicate typical absorption peak of O-H stretching vibration. Absorption at wave number (cm^{-1}): 2993.52 and 2953.02 indicates typical absorption peak of C-H sp^3 stretching vibration supported with C-H sp^3 bending vibration at wavenumber (cm^{-1}): 1415.75. Absorption at wave number (cm^{-1}): 1691. indicate typical absorption of stretching vibrations of carbonyl group (C = O) where is possibility of amide groups and carboxylic acid. Absorption at wave number (cm^{-1}): 1392.61 and 1315. indicate typical l absorption peak of O-H bending vibration and stretching vibration of C-O in carboxylic acids and the absorption at wave number (cm^{-1}): 1392.61 indicate typical C-O-H bending vibration so that shows the carboxylic groups. Absorption at wave number (cm^{-1}): 781.17, is typical absorption of stretching vibration of N-O (Silverstein, et al, 1986).

IR spectra of chitosan- ethylenediaminetetraacetate when compared with IR spectra of chitosan was observed few differences, are the loss absorption at the wave number region 1589.85 cm^{-1} which indicates the loss of amine groups. The appearance absorption bands in the wave number region 1444.68 cm^{-1} which is due to the N = N stretching vibration of azo compounds. O-H peak at wave numbers 3448.72 and 3429.43 cm^{-1} in IR spectrum of chitosan- ethylenediaminetetraacetate show a smaller intensity than the spectrum of chitosan. This is probably caused by chemical structure that connects the chitosan-ethylenediaminetetraacetate and intermolecular crosslinking through covalent bonding of ethylenediaminetetraacetate to more than one amino group on chitosan (Loretz and Schnurch, 2006).

Analysis of Surface Morphology Resin of Chitosan-EDTA With SEM

Surface morphology of chitosan-EDTA resin was characterized by scanning electron microscope (SEM), as shown in **Figure 6**.

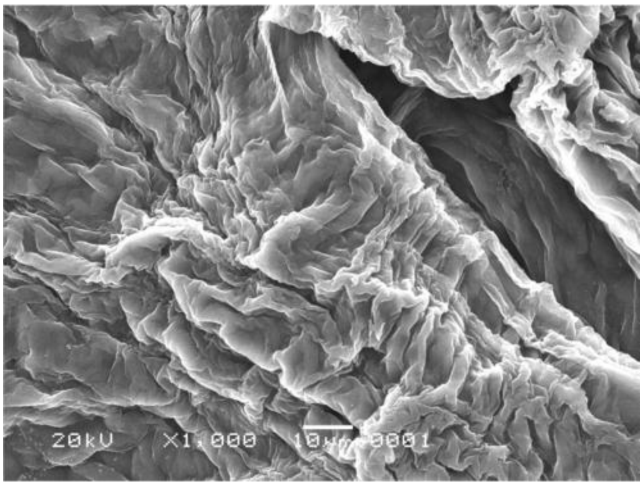


Figure 6. Photograph SEM of isolated chitosan

The surface morphology of chitosan synthesis results show a pattern of regular structure, indicates that chitosan produced a good enough quality, which is supported by the results of determining the degree of deacetylation of chitosan, which reached 60.75%. To determine whether the resin synthesized chitosan-EDTA has been successful; it can also be seen from the shape of the surface morphology, as can be seen in **Figure 7**.

Figure 7. Photograph SEM of chitosan-EDTA synthesized product

Figure 7. show the form of the surface morphology of synthesized product which nodes are suspected of EDTA bound evenly and regularly arranged on the surface morphology base is chitosan. These results indicate that EDTA has been bound with chitosan to form chitosan-EDTA complex.

CONCLUSION

Chitosan-ethylenediaminetetraacetate compounds can be synthesized by diazotation reaction of chitosan with EDTA produced 70% yield. Chitosan produced through the deacetylation reaction of chitin from windu shrimp's (*Panaeus monodon*) shell produced 64.4% yield. The Chitosan-EDTA resin was synthesized has characterization by using FT-IR spectroscopic and scanning electron microscope, shows the spesific functional groups of the resin.

REFERENCES

Amran, M.B, Panggabean, A.S., Sulaeman, A., Rusnadi (2011). *Preparation of a chelating Resin by Immobilizing 1-(2 Pyridilazo) 2-Naphtol on Polystyrene Divinylbenzene and its application as a preconcentration System for River Water Prior to Determination of Cadmium by Flame Atomic Absorption Spectroscopy*. Int. J. of Env. Res, **5(2)**. pp 531 -536.

Brine, C.J., Hirano, S. Tokura, S. (1982). *Chitin Protein Interactions, In Chitin & Chitosan*. The Japanese Society of Chitin & Chitosan:Tottori, Japan. pp. 105-110.

Cauchi, H.M.(2002). *Chitin Production by Arthropods in Hydosphere.* Hydobiologia, **470(1)**. pp. 63-95.

Chang, K.L.B. Tsai, G. (1997). *Response Surface Optimization & Kinetics of Isolating Chitin from Pink Shrimp (Solenocera melantho) Shell Waste.* J. Agric. Food Chem. **45**. pp. 1900-1904.

Dunn, E.T., Grandmaison, E.W. (1997). *Applications and Properties of chitosan*. Technomic Pub. Basel, pp. 3-30.

Dutta, P.K., Dutta, J. Tripathi, V.P. (2004). *Chitin and Chitosan: Chemistry, properties and applications.* J. of Sci. & Ind. Res. **63**. pp 20-31.

Gong, R., Li, N., Cai, W., Lui, Y., Jiang, J. (2010). *α-ketoglutaric Acid-Modified Chitosan Resin as Sorbent for Enhancing Methylene Blue Remove from Aqueous Solutions* Int. J. Environ. Res., **4(1)**: pp. 27-32.

Huang, G., Zhang, H., Shi, J.X., Langrish, T.A.G. (2009). *Adsorption of Chromium(VI) from Aqueous Solutions Using Cross-Linked Magnetic Chitosan Beads***.** Ind. Eng. Chem. **48**. pp. 2646-2651.

Junaidi, A.B., Kartini, I. Rusdiarso, B. (2009). *Chitosan Preparation with Multistage Deacetylation of chitin its and Investigation of Physicochemical Properties.* Indo. J. Chem. **9(3)**. pp. 369-372.

Katarina, R.S., Takayanagi, T., Oshima, M., Motomizu, S. (2006). *Synthesis of chitosan-based chelating resin and its application to the selective concentration and ultratrace determination of silver in enviromental water samples*. Anal. Chem. Acta. **558**. pp. 246-253.

Knorr, D. (1991). *Recovery & Utilization of Chitin & Chitosan in Food Processing Waste Management*. Food Technology. pp 114-122.

Loretz, B. dan Schnurch, A.B. (2006). *In Vitro Evaluation of Chitosan-EDTA Conjugate Polyplaxes as a Nanoparticulate Gene Delivery System*. The AAPS J. **8(4)**. pp 756-763.

Muzzarelli, R.A.A. (1984). *Chitin*. Faculty of Medicine. University of Ancona. Italy.

Nakano, T., Ikawa, N. Ozimek, L. (2004). *Use of Ephicholorohydrin-treated Chitosan Resin as an Adsorbent to isolate k-Casein Glycomacropeptide from Sweet Whey*. J.Agric. Food Chem, **52**. pp.7555-7560.

Roberts, G.A.F. (1992). *Chitin Chemistry*. Macmillan press,LTD. pp 85-91.

Silverstein, R.M., Bassler, G.C. Morril, T.C. (1986). *Penyidikan Spektrometrik Senyawa Organik*. Erlangga. Jakarta.

Srijanto, B., Pryanto, I., Masduki, Purwatiningsih. (2006). *Pengaruh Derajat Deasetilasi Bahan Baku Pada Depolimerisasi Kitosan*. Akta Kimindo, 1(2). pp 67-71.

Sykes, P. (1989). *Penuntun Mekanisme Reaksi Kimia Organik*. Gramedia. Jakarta.

Wan, N.W.S. (2002). *Reactive and Functional Polymers*, 50. pp 181-190.

Antioxidant Activity of Essential Oil and Crude Extracts from Kaffir Lime Leaves (*citrus hystrix*) in East Borneo

Netty Maria Naibaho[1], Khusnul Khotimah[2]

[1,2]*State of Agriculture Polytechnic Samarinda, East Borneo*
e-mail: maria_nethy@yahoo.com

ABSTRACTS

Kaffir lime levaes is one of citrus cultivars in Indonesia that used as a food ingredient. The antioxidant activity of essential oil and crude extracts of Kaffir lime leaves in East Borneo was determined.The antioxidant potential of the samples was evaluated using two separate methods, inhibition of free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2-azino-bis 3ethylbenzothiazoline-6-sulphonic acid (ABTS).Results showed that the ethanol extracts were able to reduce the stable free radicals (DPPH and ABTS) with 49,5 µmol TE/mg and 42,8 µmol TE/mg, respectively.The total phenolic compounds were 4,06 µg GAE/mg. The essential oils from fresh leaves showed inhibition (DPPH) and (ABTS) at 5,78µmol TE/mg and 5,12µmol TE/mg, respectively. The strong antioxidant activity of the plant extracts may be attributed to the presence of phenolics.

Keywords: Antioxidant activity, Crude extracts, Essential oil, Phenolic Compounds, and Kaffir Lime Leaves

INTRODUCTION

The microorganism is not the only problem in food processing. Free radical reactions occur in the food system and the human body.Free radical reactions also affect the food processing system and the human body. Oxidation trigger free radicals which are an integral part of the normal physiology in the form of reactive oxygen and nitrogen species (Wong, *et al.*, 2006). Oxidation is a chemical reaction that transfers electrons or hydrogen from a substance to an oxidizing agent. For example, oxidation can be an irreversible process in which oxygen molecules combined with the nutrients in food (such as carbohydrates, protein, and fats). This process will degrade the quality of food. In this case, the problem of oxidation can be overcome by adding antioxidant agents into food ingredients. Antioxidants have been widely used in the food industry to prolong the shelf life of food. The most commonly used antioxidants at the present time are butylatedhydroxyanisol (BHA), butylatedhydroxytoluene (BHT), propyl gallate (PG) and tetra-butylhydroquinone (TBHQ). However, BHA and BHT have been suspected of being responsible for liver damage and carcinogenesis (AbouArab and Abu-Salem, 2010; Audipudi and Chakicherla, 2010). Therefore, it is very important to find new sources of safe and inexpensive antioxidants from natural origins (Oktay*et al.*, 2003). Natural antioxidants can protect the human body from free radicals and retard the progress of rancidity in foods (Abou-Arab and AbuSalem, 2010). In addition, the presence of phenolic compounds (phenolic acids and polyphenols) in plants has gained more attention because of their various functions, such as antioxidant activity and flavoring properties (Sacchetti*et al*., 2005). Consumption of foods containing natural extracts of aromatic plants is expected to prevent the risk of many free radical mediated diseases. Kaffir lime (*Citrus hystrix D.C*) is a herbaceous plant which is used mainly fruits and leaves as food seasonings. At first the term "essential oils" is the term used for the oil that is volatile, which consists of a mixture of volatile substances, the composition and boiling point is different. The volatile essential oil contained in the oil glands to be released before the detailed namely by chopping/ cutting plant tissues and opening the oil glands as much as possible, so that the oil can be easily evaporated. The plant was extracted with different extraction methods and different plant conditions.

Hydrodistillation and solvent extraction appears to be an excellent method for extracting the plant's essential oils as it results in good yields and good recovery of essential oil constituents, is less laborintensive, and is a simple and fast method (Sarfraz*et al*., 2011). Those different extraction methods affect the organoleptic profile that shows the differences in the composition of the oils obtained by solvent extraction as opposed to distillation; this also affects the chemical properties and volatile compounds (Hashemi*et al*, 2008; Atti-Santos *et al*., 2005). Therefore, the aims of this study were to examine the effects of the different extraction methods on the antioxidant activity of the crude extracts and essential oils from Kaffir lime leaves.

MATERIALS AND METHODS Plant material

Fresh Kaffir lime leaves purchased from a local farmers from the East Kutai Regency in Kota Bangun, East Borneo, Indonesia.

Extraction procedure Solvent extraction

Extracts were prepared by adding plant materials (20 g dry weight) with 99% ethanol, hexane and acetone (1:2 w/v). After 24 hours, the mixtures were filtered through Whatman No. 1 filter paper. The extract was concentrated with a vacuum rotary evaporator. This process produced concrete/crude extracts. The extract was stored in a brown bottle at 4 °C before analysis. The waste or residues after the first extraction of plant materials was repeated three times with the same solvent, similar to the above condition. All of the extracts were conducted using a randomized complete block design

(RCBD) with three replicates.

Hydrodistillation

Essential oils of Kaffir lime leaves were extracted by hydrodistillation and all operations were carried out at room temperature. The samples (fresh and dry form) were mixed with distilled water. The essential oils were extracted by hydrodistillation using a vertical hydrodistillation unit. A flask containing the homogenate was heated for 24 hours and the vapor was condensed. It was also separated throughout by an auto-oil/water separator. Each essential oil extraction was done in triplicate by a completely randomized design (CRD). The physical and chemical properties were then analyzed.

Total phenolic compounds

The total phenolic compound was obtained by the Folin-Ciocalteau method. The sample (50 µL) was diluted until it was 1 mL in distilled water. This was continued with the addition of 5 mL of freshly prepared 20% Folin–Ciocalteu Reagent (FCR). The mixture was allowed to equilibrate for 5 min and then mixed with 4 ml of 20% (w/v) Na_2CO_3 solution. After incubation at room temperature for 2 hours, the mixture was centifuged for 10 minutes. The absorbance of supernatant was read at 765 nm using the respective solvent (ethanol) as a blank. The concentration of total phenolic compounds in extracts of Kaffir Lime leaves was expressed as µg of gallic acid equivalents (GAE) per mL of sample. All tests were run in triplicate and analyses of all samples were run in duplicate and averaged.

Antioxidant activity 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay

The free radical scavenging activity of plant extracts was measured by DPPH according to Devi *et al*. (2008) with modification. Samples were prepared by adjusting the concentration of crude extracts and essential oils to 2000 ppm by diluting in 99% ethanol. 100 µL of each diluted sample was added to 3 mL of 0.1 mM DPPH ethanolic solution and shaken vigorously. The mixture of samples and DPPH were placed in dark conditions at room temperature for 30 min. The absorbance of the resulting solution was measured at 517 nm by a UV-visible spectrophotometer. A low absorbance of the reaction mixture indicated high free radical scavenging activity. Ethanol as a solvent was used as the control. The percent DPPH scavenging effect was calculated as follows:

$$\%\text{ DPPH Scavenging} = \frac{(A\text{blank} + A\text{ sample+ethanol})-A\text{sample}}{(A\text{blank} + A\text{sample+ethanol})} \times 100\%$$

Where *A*blank is the absorbance of the control reaction (ethanol), *A* sample+ethanol was the absorbance of the sample without DPPH solution and *A* sample was the absorbance of the sample mixed with DPPH solution. To obtaine the standard equation, TROLOX solution in various concentrations was used.

2,2'-azino-bis(3-ethylbenzthiazoline-6sulphonic acid) (ABTS) assay

The antioxidant activity of plant extracts was measured by ABTS assay according to Devi *et. al* (2008). Samples were prepared by adjusting the concentrations of plant extracts and essential oils to 2000 ppm by diluting in 99% ethanol. The 5 mL of ABTS solution was added to 50 µL of samples, shaken vigorously, allowed to stand in dark conditions at room temperature for 6 minutes and then the absorbance was measured at 734 nm with a UV-visible spectrophotometer. Ethanol was used as a solvent for the control. To obtain the standard equation, TROLOX solution in several different concentrations was used.

Statistical analysis

SAS program Windows Release Version 8.02 (SAS Institute Inc., Cary, NC, USA) was used for statistical analysis of the experimental data. Analysis of variance (ANOVA) of antioxidant activities of plant extracts from Kaffir lime leaves were analyzed using SAS Program. Means were separated by Duncan's Multiple-Range Test (DMRT).

RESULTS AND DISCUSSION

Total phenolic compounds of the crude extracts and essential oils from Kaffir Lime leaves were conducted by the *Folinciocalteau*method. Total phenolic compounds of extract Kaffir lime leaves it as shown in Table 1. Depending on the time of treatment and methods of extraction, TPC of the first ethanol extract gave the highest values ranged from 13.01 µg GAE/mg dry extracts. These were followed by the second ethanol extracts, the third ethanol extracts, the first acetone extracts, the second acetone extracts, the third acetone extracts, the first hexane extracts, the second hexane extracts and the third hexane extracts which were 13.01,12.67,11.60,10.68, 10.08, 9.63, 7.55, 7.37 and 7.29 µg GAE/mg dry extracts, respectively. However, lowest value of total phenol in water vapor distillation extraction method, which were 4.12 and 5.78 µg GAE/mg dry extracts. Jamilah, *et al.* 2011, reported that the ethanol extracts of Kaffir Lime leaves obtained using supercritical carbondioxide extraction gave the high total phenolic compound with were 112.7 mg GAE/g extract. The ethanol extracts contained the highest content of phenolic compounds due to their active compounds. This compound may have affected the total phenolic compounds of Kaffir Lime

Table 1. Effect of extraction methods and different solvents on total phenolic compounds of crude extracts and essential oils from Kaffir Lime

	b			
$A_1 B_1$	11,52	11,77	11,50	11,60
$A_1 B^1$	12,05	13,32	12,65	12,67[a]
$A_1 B_3$	12,89	13,09	13,05	13,01[a]
Rata -rata (%)	15,99	12,72	12,40	
N-hexane (A_2)				
A_2B_1	7,28	7,38	7,21	7,29[d]
A_2B_2	7,37	7,38	7,37	7,37[d]
A_2B_3	7,51	7,59	7,56	7,55[d]
Rata -rata (%)	7,38	7,45	7,38	
Acetone (A_3)				
A_3B_1	10,10	9,45	9,32	9,63[c]
A_3B_2	10,56	9,78	9,89	10,08[b]
A_3B_3	11,42	11,23	9,39	10,68[b]
Rata -rata (%)	10,69	10,15	28,6	

a,b,c.

(DL: distillation extraction)

different letters in the same column are significantly different at p≤0.05

leaves.Thus, Idris*et al*. (2008), reported that the active ethanol extracts may be due to partial degradation of the extracted compounds due to long extraction time when conventional extraction methods are to be used. Hussain *et al*. (2008) and Matasyoh*et al*. (2008) reported that several factors may affect the chemical composition and biological activities of plants such as the part of plant, seasonal variations, location, solvent extraction, and the amount of the sample, which in turn affects the content of phenolic compounds. In addition, ethanol was the most effective solvent for recovering phenolic compounds from plant extracts. Generally, extracts with a high amount of phenolic compounds also exhibit high antioxidant activity. Ethanolic extracts of Kaffir Lime leaveswhich showed high total phenolic content also had high antioxidant activities. Comparing between the antioxidant array and total phenolic content, the ethanolic extracts had higher antioxidant activities than the other solvent extractions. This can be explained by the different responses of various phenolic compounds with different analytical methods. Moreover, it depends on the number of phenolic groups present in plants. This indicates that, in this research, the polyphenols in the ethanolic extracts were partly responsible for the antioxidant activities. In addition, total phenolic content does not necessarily incorporate all the antioxidants that might be present in an extract and plants contained a variety of effective antioxidant substances (Yanishlieva-Maslarova.,2001)

Antioxidant activity

Content of antioxidants derived from plants, which are the most important substances that have the ability to protect the body from damage caused by free radicals, in this case the oxidative stress (Ahmad *et al*., 2011). The active constituents of plant tissues are mainly its secondary metabolites. These metabolites are naturally produced during different plant and extraction method. In this research, the antioxidant activity of plant extracts from the Kaffir lime leaves was carried out by two methods: free radical scavenging activity and trolox equivalent by the DPPH and ABTS assay. The results are shown in Table 2. Among of extraction method, the solvent extraction gave the highest antioxidant activity. This study showed that the first ethanol extract resulted in the highest antioxidant activity of % free radical scavenging activity and the μmol TE/mg by the DPPH assay and ABTS assay was 50,15 %, 49,51μmol TE/mg, and 42,80 μmol TE/mg. The first acetone extracts also gave the highest antioxidant activity of % free radical scavenging activity and 36,07 μmol TE/mg by the DPPH assay and ABTS assay, followed by the second acetone, the third acetone, the first hexane, the second hexane, and the third hexane extracts. The ethanol extracts gave the highest antioxidant activity because ethanol was proved to be an effective solvent to recover antioxidant compounds such as phenolic compounds and pigment compounds i.eanthocyanins and chlorophylls. Beside that Meireles, 2009, reported that the solvent extraction method was more effective to recover antioxidant compounds from plant. The antioxidant activity of the ethanol and acetone extracts in this study was higher than steam destillation extraction. However, the extraction of fresh leaves in DPPH and ABTS assay gave the highest antioxidant activity was 32.46 and 32.01 μmol TE/mg, followed by extraction of dry leaves was 28.32 and 29.19 μmol TE/mg, respectively. The antioxidant activity of % free radical scavenging activity was 32.23 μmol TE/mg and 28.75 μmol TE/mg of extraction fresh and dry leaves essential oil of Kaffir lime. The free radical scavenging capacity of the crude extracts was noted to have increased in a concentration dependent manner. In the DPPH assay, the ability of the examined crude extracts to act as donors of hydrogen atoms or electrons in transformation of DPPH• into its reduced form of DPPH was investigated. All of the assessed samples were able to reduce the stable, purplecolored radical DPPH into yellow-colored DPPH. The greatest effect was obtained from crude extractsin the first ethanol extraction (49,51µmol TE/mg), which was more effective than ABTS (42,80 µmol TE/mg), while the smallest effect was noted by the hexane extracts. The lower antioxidant activity of fresh and dry leaves than solvent extraction (ethanol, n-hexane, and acetone) due to higher the absorbance, the higher the concentration of peroxides formed during reaction, which will consequently lower the antioxidant activity. Nevertheless, it is difficult to attribute the radical scavenging/antioxidant activity of entire crude extracts and essential oils to one ,because the crude extracts and essential oils are a complex mixture of different chemical compounds. Normally, the antioxidant activity of the whole essential oils showed better antioxidant/radical scavenging capacity than the individual components, indicating possible synergistic interactions between different components of essential oils. The antioxidant activity of essential oils may be attributed to the presence of phenolic compounds (Lu and Foo, 2000). The variation in the level of inhibition of peroxidation within different extraction methods might be due in part to the varied contents of phenolics of the essential oils.

Table 2. Effect of extraction methods and different solvents on µmol TE/mg (DPPH and ABTS assay) compounds of crude extracts and essential oils from Kaffir Lime

Extraction Methods	%free radical scavengging		Total
	DPPH (µmol TE/mg)	ABTS (µmol TE/mg)	
DE -Fresh leaves	32,46b	32,01b	32,23b
DE -dry leaves	28,32c	29,19c	28,75c
Rata-rata	30,39	30,60	
Ethanol (B_1)			
B_1 A_1	49,51a	42,80a	50,15a
B_1 A_2	37,52b	34,44b	35,92b
B_1 A_3	29,81c	22,62d	26,21c
Rata-rata (%)	38,94	33,28	
N-hexane (B_2)			
B_2A_1	19,78e	16,69f	18,23e
B_2A_2	18,12e	17,77f	17,94f
B_2A_3	14,24g	15,35g	14,79g
Rata-rata (%)	17,38	16,60	
Acetone (B_3)			
B_3A_1	38,50b	33,64b	36,07b
B_3A_2	38,24b	30,53c	24,39
B_3A_3	29,92c	27,44	28,68c

Rata -rata (%)	35,55	30,54

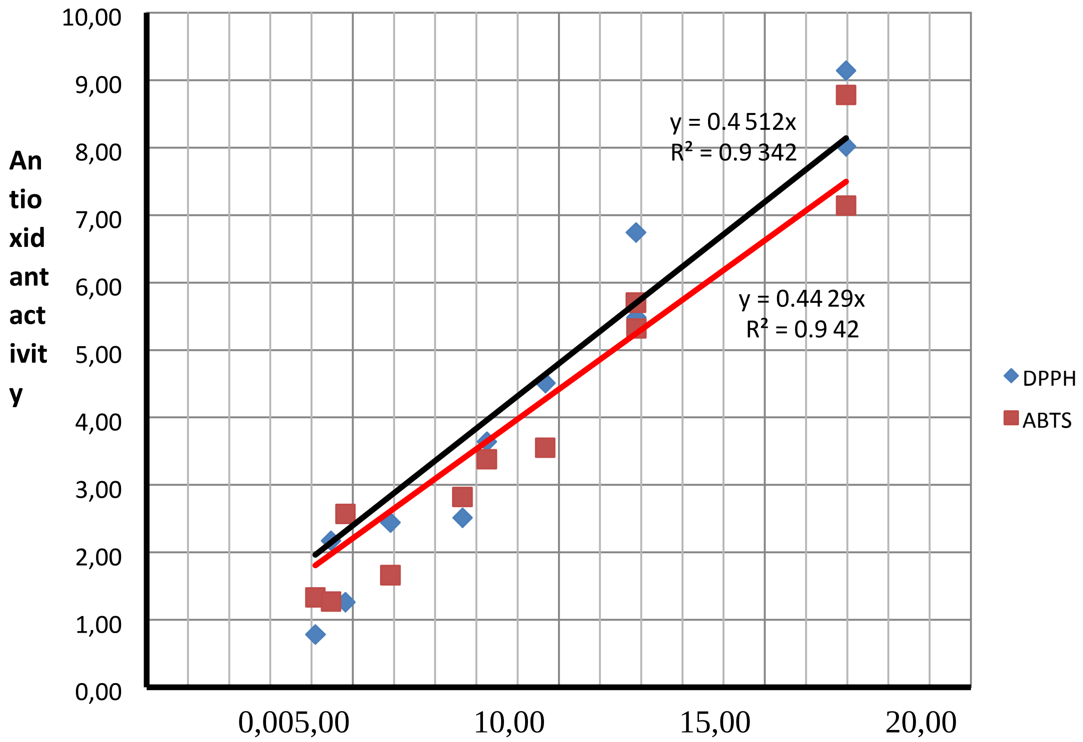
a,b,c, different lettes in the same column are significantly different at p≤0.05

2) (DE: distillation extraction)

Correlations of total phenolic content and antioxidant activity plant extracts from Kaffir Lime

The correlations of total phenolic compound and antioxidant activity (DPPH and ABTS*) from plant extracts of Kaffir lime was identified. The result indicated that both methods showed the same trend. The highest antioxidant activity for TPC, DPPH and ABTS activity assay was ethanol extraction, followed by first acetone extracts and first hexane extracts. The activity of DPPH and ABTS assay increased activity and also increased the total phenols which were r2=0,96 for DPPH and r^2=0.94 for ABTS. A strong correlation among TPC, DPPH and ABTS implied that antioxidants in these plants were capable of scavenging free radicals (DPPH• and ABTS•+) and reducing oxidants (ferric ions). Many studies have demonstrated the ferric ion reducing ability of antioxidants that correlates with the results from other methods used to estimate antioxidant capacity. This could be explained by the basic concept that antioxidants are reducing agents. Antioxidants are compounds capable of donating a single electron or hydrogen atom for reduction, but reducing agents may not express antioxidants. On the other hand, hexane extracts had a lower antioxidant activity assay which means the antioxidants act differently with two different free radicals (DPPH· and ABTS·+). Both DPPH and ABTS•+ assays have been widely used to measure the antioxidant activities of natural extracts based on their abilities to scavenge free radicals. The reactions of DPPH assays are determined in the absence of added DPPHH, while the reduced form of ABTS is usually present in test systems containing ABTS•+. In addition, the reaction time of discolouration for the ABTS•+ assay is only 6 min, which is much shorter than that for the DPPH assay (30 min for this study). Therefore, it may affect the antioxidant activities of each assay. The antioxidant activity largely depends on the composition of the extracts and the assay methods. The same antioxidants may yield significantly different activities when assessed using different methods. It is thus necessary to perform more than one type of antioxidant activity measurement to take into account the various mechanisms of antioxidant action (Burhan*et al*., 2010).

In addition, the ability for phenolic compounds to scavenge DPPH free radicals and reduce ABTS•+ radical cations depends on the availability of properly oriented functional groups. While the Folin-Ciocalteu assays estimate the sum of phenolic compounds present in plant extracts, Singleton and Rossi (2004) stated that various phenolic compounds respond differently in each assay depending on the number of phenolic groups. This indicates that, in this research, the polyphenols in the ethanolic extracts were partly responsible for the antioxidant activities. In addition, TPC does not incorporate necessarily all the antioxidants that may be present in an extract and plants contain a variety of effective antioxidant substances.



Total phenolic (µg GAE/mg)

Figure 1. Relationship of total phenolic content and antioxidant activi of extracts and essential oils of Kaffir Lime leaves.

CONCLUSION

The different extraction methods showed different results in all types of extracts. The solvent extraction produced from crude extracts gave the highest total phenolic compound (13.01 µg GAE/mg dry extracts), % free radical sacavengging (50,15µmol TE/mg), 1,1-Diphenylpicrylhydrazyl (49,51 µmol TE/mg), dan 2,2'-azino-bis(3-ethylbenzthiazoline-6sulphonic acid (42.80 µmol TE/mg), which was followe by first acetone extraction. The crude extracts contained both hydrophilic and hydrophobic compounds, while the distillation extraction process produced high levels of hydrophobic compounds. The first ethanol extract produced better antioxidant activity than acetone, hexane and destillation extraction of fresh and dry leaves of plant extracts Kaffir Lime leaves. On the overall, ethanol extraction was better for extracting total phenol compounds and antioxidant activity of Kaffir Lime leaves.

ACKNOWLEDGEMENTS

This work was supported by the Directorate of Human Resources of the Directorate General of Higher Education (DGHE) Indones.

REFERENCES

Abou-Arab, E. A. and Abu-Salem, F. M, 2010, "Evaluation of bioactive compounds of *Stevia rebaudiana* leaves and callus", African Journal of Food Science, Vol, 4(10), pp. 627–634.

Ahmad, N., Fazal, H., Haider, B.A., Inayat,U.R., Shazma, A., Mubarak, A.K., Abdul, B., Humaira, I., Roshan, Z., Shahid, A.K., and Kiran, Y.K., 2011, "DPPH-scavenging antioxidant potential in regenerated tissues of *Stevia rebaudiana*, *Citrus sinensis*and *Saccharumofficinarum*", Journal of Medicinal Plants Research Vol. 5(14), pp. 32933297.

Atti-Santos, A.C., Rossato, M., Serafini, L.A., Casse, E. and Moyna. P, 2005,"Extraction of essential oils from lime (*Citrus latifolia*Tanaka) by Hydrodistillation and supercritical carbon dioxide", Journal of Brazilian Archives of Biology and Technology, 48 (1): 155-160.

Audipudi, A.V. and Chakicherla, B.V.S., 2010, "Antioxidative and antimicrobial activity of methanol and chloroform extracts of *Gmelinaarborea*Roxb", International Journal of Biotechnology and Biochemistry, 6 (1): 139–144.

Chew, K.K., Khoo, M.Z., Ng, S.Y., Thoo, Y.Y., Wan Aida, W.M. and Ho, C.W., 2011a, "Effect of Ethanol Concentration, Extraction Time and Extraction Temperature on The Recovery of Phenolic Compounds and Antioxidant Capacity of *Orthosiphonstamineus*Extracts", International Food Research Journal, Vol. 18, No. 4, pp. 1427-1435.

Devi, K.P., Suganthy N., Kesika P., and Pandian, S.K., 2008, "Bioprotective Properties of Seaweeds", Malaysian Journal of Nutrition, Vol. 8, No. 2, pp. 16717.

Frankel, E.N., and Meyer, A.S., 2000, " The problem of using onedimensional method to evaluate multifunctional food and biological antioxidants", Journal of the Science of Food and Agriculture, 80:1925-1941.

Hashemi,P.,Abolghasemi,M.M.,Ghiasvand, A. R., Ahmadi, S., Hassanvand, H.,Yarahmadi,A.,2008,"ACompar ative Study of Hydrodistillation and Hydrodistillation–Solvent Microextraction Methods for Identification of Volatile components of *Echinophoracinerea*", Journal of Chromatographia, 69: 179-182.

Hussain, A. I., Anwar, F., Sherazi, S. T. H., and Przybylski, R., 2008, "Chemical composition, antioxidant and antimicrobial activities of basil (*Ocimumbasilicum*) essential oils depends on seasonal variations", Food Chemistry, 108: 986-995.

Matasyoh, L. G., Matasyoh, J. C., Wachira, F. N., Kinyua, M. G., Muigai, A. W. T. andMukiama, T. K., 2007, "Chemical composition and abtimicrobail activity of the essential oil of *Ocimimgratissimum*L. growing in Eastern Kenya", African Journal of Biotechnology, 6: 760765.

Meireles, M.A.A., 2009, Extracting Bioactive Compounds for Food Products: Theory and Applications, CRC Press, Boca Raton.

Lu, Y., and Foo, L.Y., 2000, "Antioxidant and radical scavenging activities of polyphenols from apple pomace". Food Chemistry, 68: 81–85.

Sacchetti, G., Maiett, S., Muzzoli, M., Scaglianti, M., Manfredini, S., Radice, M., and Bruni, R., 2005, "Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods", Journal of Food Chemistry, 91, 621–632.

Sarfraz et al., 2011," Characterization of Basil (ocimumBasilicum L.) parts for antioxidanat potential". African Journal of Food Science and Technology, vol, 2(9), pp. 204-213.

Shih Peng Wong, Lai Peng Leong, Jen Hoe William Koh., 2006.

Antioxidant activities of aqueous extracts of selected plants. Food Chemistry 99 (2006) 775–783.

Singleton, V.L. and Rossi, J.A., 1965, “Colorimeter of Total Phenolics with Phosphomolybdicphosphotungstic Acid Reagent”, American Journal of Enology and Viticulture, Vol. 16, pp. 144-158.

Yanishlieva-Maslarova, N.V., 2001, “Inhibiting oxidation. In Pokorny, J., Yanishlieva, N.and Gordon, M.H. (Eds.), Antioxidants in food: practical applications, 22–70. Cambridge: Wood Publishing Limit

LEARNING STYLES RELATIONSHIP TO VALUE GPA CHEMISTRY EDUCATION STUDENTS MULAWARMAN

Abdul Majid
Science Education Department, Chemistry Education ,
Mulawarman University

ABSTRACT

The student's learning style is typical of the way a person in performing activities of learning, where learning style is one factor that can affect student cumulative grade point. Therefore, research on "Learning Styles Relationship To Value GPA Chemistry Education Students Mulawarman". This study was aimed to investigate the relationship between the student learning styles of cumulative grade point Mulawarman Chemical Education.

The method was used in this research is the descriptive analytic. The samples were Mulawarman chemistry education students cluster random selected as many as 127 students. The data collection was performed by two methods: the questionnaires and interviews.

The results of the study were analyzed using product moment correlation test with significance level of 0.05 were performed with SPSS. Which was obtained r = 0.231 (low correlation), t_{hit} = 2.81185 and t_{tab}=1.65714 so t_{hit}>t_{tab}. Hα means that Ho is rejected and accepted, that there is a significant correlation between learning styles on the value of the cumulative grade point (GPA) students of chemical education Mulawarman.

Keywords: Learning Styles, Cumulative Grade Point

PRELIMINARY

The experts in education tries to develop the theory about learning style as a way to find road making studying becomes easy and exciting thing. Someone's abilty to understand and absorb the lesson must have had different level. There is fast, medium, and also extremely slow. Each individual doesn't only study by different speed but proccesses the information by different way.

Learning style is a combination how someone absorbs and then arranges also cultivates the information. Learning style is not only as aspect when facing information, seeing, listening, writing and saying but also as aspect proccessing sequential information, analytic, global or left brain and right brain. Felder (1993) devided learning style into 8 model using ILS *Questionnare* intrument. The model which is developed such as : *sensing, intuitive, visual, verbal, active, reflective, sequential,* and*global.* On those learning styles, a college student on certain scale (for example for visual or verbal) might have been strong, medium, or balance and it can be variety on the subject or other studying environment.

Recognizing an own learning stlye is not necessarily making us smarther. It will determine more effective how to learn. A college student will know how to use studying abilty maximally so the studying result which is got become optimal.

Research of learning style using ILS intrument has been done in various countries. One of them is done by Zubaidah Begam Mohamed Zakaria (2007). She has made one research of learning style to 369 students in the Education Faculty, University Technology Malaysia, Skudai, Johor using a set of questionnaire intruments of *Felders Index of Learning Styles.*

He found out that learning style which becomes mayority of student in the Education Faculty is Visual learning stlye as much as 85%. It becomes mayority because the student can memorize something easily to what they see.

Dealing with compulsion to study definitely isn't a good thing and won't be easy for college students to concentrate for studying if they feel forced. Therefore, it need to be searched solution how to make learning become delighted thing although it feels forced. However, it can be easier and effective, so the result of studying of college student will be better. Some researches, which mean identifying learning styles of college students, find out that college students with certain learning styles indicate better achievement because they feel satisfied during they're following the lecture. Another result indicates that college studends with learning style which is the same as certain college lectures, tending having better performance or higher of the level of satisfaction.

Based of statements above, the writer feels interested to do research about "*Learning Styles Relationship To Value GPA Chemistry Education Students Mulawarman"*

RESEARCH METHODS

This research was done in Mulawarman Chemical Education. The population of this reasearch were Mulawarman Chemistry Education students. Taking samples, were done with

Cluster Random Sampling technical, were 50% from amount of Mulawarman Chemistry Education students 2012 generation as many as 35 students, 2013 generation as many as 63 students and 2014 generation as many as 29 students with total student as many as 127 students.

Independent variable of this reasearch is Learning Styles Relationship To Value GPA Chemistry Education Students Mulawarman.

Resourches of this research are questionnaire, documentation, and interview. Data retrieval intrument research is Index of Learning Style (ILS) Questionnaire by Felder and Solomon.

Data which was got from questionnaire can determine scale of learning styles of college students tend (1) sensing or intuitive, (2) visual or verbal, (3)active or reflective and (4) sequential or global in number. The number which is got from those learning styles, devides to positive and negative.

Score which is got from questionnaire will be counted the value to know how coefficient correlation which shows relationship of learning style using product moment formula, the value of coefficient correlation will be interpreted as the following table :

Table 1

The magnited of the Correlation	**Category**
0,800 <value ≤ 1,00	Very High
0,600 <value ≤ 0,800	High
0,400 <value≤ 0,600	Medium
0,200 <value ≤ 0,400	Low
0,000 <value ≤ 0,200	Very Low

Next, Dertemining sifnificant correlation using test with signification testing rule :

If $t_{arithmetic} < t_{table,}$Ho is accepted.It means that there isn't significant relationship between Learning Styles and Value GPA students.

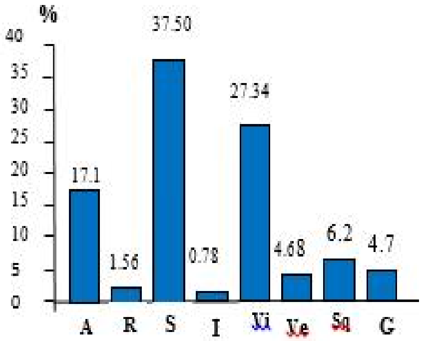
If $t_{arithmetic} \geq t_{table,}$Ho is accepted.It means that there is significant relationship between Learning Styles and Value GPA students.

RESULTS AND DISCUSSION

Research Result

The result of learning styles identification indicates that almost of Mulawarman Chemistry students have dimensional perception of learning styles which are sensing leaning style and verbal learning style. Overall, the percentage of student's learning style can be viewed on

Picture 1.
dimensional perception learning styles



1. Precentage of Dimensional Perception of Learning Styles

Table2.

		Precentage	GPA Avarage
Sensing	Strong	22.83%	3.18
	Medium	14.17%	3.17
Sensing-Intutive	Balance	0%	-
Intuitive	Medium	0.78%	3.24
	Strong	0%	-

2. Precentage of Dimensional Input of Learning Styles

Table 3.

		Precentage	GPA Avarage
Visual	Strong	9.44%	3.23
	Medium	14.96%	3.16
Visual-Verbal	Balance	1.57%	3.04
Verbal	Medium	3.93%	3.17
	Strong	0%	-

3. Precentage of Dimensional Proccessing of Learning Styles

Table 4.

		Precentage	GPA Avarage
Active	Strong	11.81%	3.16
	Medium	4.72%	3.02
Active-Reflective	Balance	0.78%	3.24
Reflective	Medium	0.78%	3.31
	Strong	0.78%	3.24

4. Precentage of Dimensional Undertanding of Learning Styles

Table 5

		Precentage	GPA Avarage
Squential	Strong	3.14%	3.36
	Medium	2.36%	3.35
Sequential-Global	Balance	0.78%	2.69
Global	Medium	4.72%	3.05
	Strong	0.%	-

Statitic test which is used to test existence between Learning Styles and Value GPA Chemistry Education Students Mulawarman is colleration of product moment with significant degree(α) is 0,05. The result of the research shows that there is a relationshop between learning styles and Value GPA Chemistry Education Students Mulawarman which is indicated from the result of pearson correlation is 0.02515 with low correlation category.

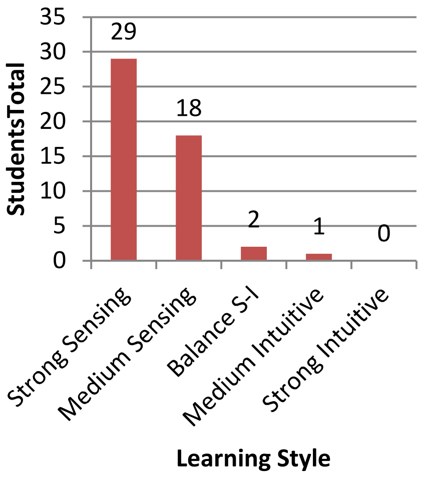
Discussion

Each individual has own learning styles which might be similiar but not the same. In this case, learning styles which is thought by Felder, devided by 4 dimensional which are dimensional proccessing (*active-reflektive*), dimensional input(*visual-verbal*),dimensionalperseption (*sensing-intuitive*), and dimensionalunderstanding (*sequential-global*). Those learning styles have own way to reach studying destination

1. *Sensing-Intuitive Learning Styles* (Dimensional Pereceptio)

   The result of the research shows that students who have sensing-intuitive learning style (dimensional perception) are 48 students or as many as 37.79% of all amount of samples. Based of students mapping, if it's classified into dimensional perception, the result can be presented on this picture

Picture 2.

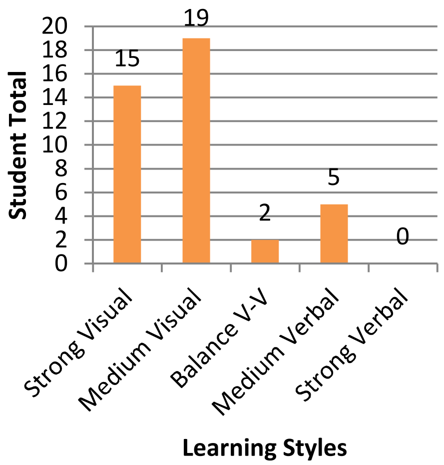


The most dominant of learning styles on this dimensional is strong sensing. According to Felder, the student, which has sensing learning style with strong prefens, prefers solving the problems by detail procuders and working detail.

1. *Visual-Verbal*Learning Style (Dimensional Input)

The result of the research shows that students who have visual-verbal learning styke (dimensional input) are 41 students or as many as 32.28% of all amount the samples. Based of students mapping, if it's classified into diemansional perception, the result can be presented on this picture

Picture 3

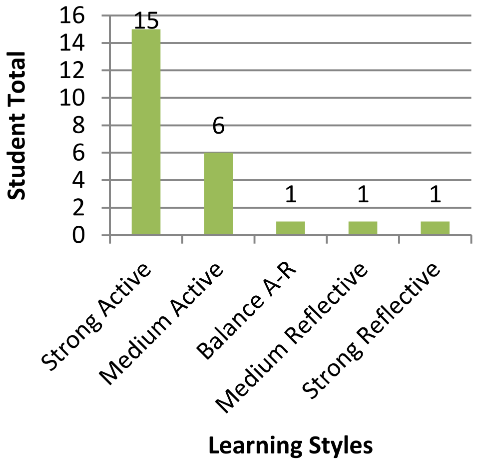


Most of the students have medium visual learning style and the second type is strong visual learning style. According to Felder that the students, who have visual learning style by trending in, prefer getting the information by visual (picture, diagram,graph,scheme, demonstration)

2. *Active-Reflective*Learning Style(Dimensional Proccessing)

The result of the research shows that students who have active-reflective learning style (dimensional proccessing) are 24 students or as many as 18.89% of all amount of samples. Based of students mapping, if it's classified into dimensional perception, the result can be presented on this picture

Picture 4.

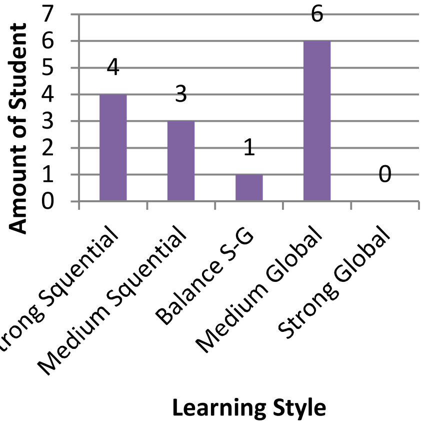


Most of the students have strong active learning style. They will like studying proccessing if they're working group, when they're practical and so on, which is more centered on students, so they'll be more active.

3. *Squential-Global* Learning Style (Dimensional Understanding)

The result of the research shows that students who have sequential-global learning style (dimensional proccessing) are 14 students or as many as 11.02% of all amount of samples. Based of students mapping, if it's classified into dimensional perception, the result can be presented on this picture

Gambar 5



Most of the students have the most dominant learning style is medium global and the second type is strong sequential. The student who has global learning style, has a weakness. If the teacher examines a new topic without explaining how the relation of that topic with student's studying understanding which has been studied by the students previously.

Based on learning style data and student's value GPA, we knew that almost of students Chemisty Education Mulawarman have strong sensing learning style with the avarage of their GPA is pretty good which is 3.18. Therefore, it will be better if in studying proccessing, it's connected with the facts, given the procedur detail, and given more time to do something with abstrac concept so the result will be more maximall because they tend doing abstrac concept slowly. This learning style will be seen its relationship with student's GPA in each dimensional such as :

1. DimensionalPersepsition Learning Style (*Sensing-Intuitive)*

   Based on the research which is done, we can conclude that dimensional perseption has cofficient corelation which is 0.123 where is located between 0.000-0.200 very low corelation category which means that learning style in this dimensional only gives constribution as many as 1.5129 % to student's value GPA while 98.4871% is affected by other factors.

2. Dimensi Input Learning Style (*Visual-Verbal)*

   Based on the research which is done, we can conclude that dimensional input has cofficient corelation which is 0.399 where is located between 0.200-0.400 low corelation category which means that learning style in this dimensional only gives constribution as many as 15.9201% to student's value GPA while 84.0799% is affected by other factors.

3. Dimensional Proccessing (*Active-Reflective)*

Based on the research which is done, we can conclude that dimensional proccessing has cofficient corelation which is 0.082 where is located between 0.000-0.200 very low corelation category which means that learning style in this dimensional only gives constribution as many as 0.6724 % to student's value GPA while 99.3276 % is affected by other factors.

4. DimensionalUnderstanding (*Squential-Global)*

Based on the research which is done, we can conclude that dimensional understanding has cofficient corelation which is 0.4965 where is located between 0.400-0.600 medium corelation category which means that learning style in this dimensional only gives constribution as many as 24.65 % to student's value GPA while 75.35 % is affected by other factors.

Based on those results, we can sorted that dimensional learning styles which have the strongest relationshop with student's GPA is dimensional understanding (sequential-global). Dimensional input (*visual-verbal),* dimensional perseption *(sensing-intuitive),* and the lowest one is dimensional proccessing pemrosesan*(active-reflective).*

CONCLUSION

Based on the result of the research which done, we can conclude that there is significant relationship between learning style and student's GPA. Furthermore, learning style which has the strongest relationship is visual learning style.

BIBLIOGRAPHY

Abosalem, Y. M.. 2013. "The Relationship Between the Learning Styles of Students in Grades Five and Six and Their Held Misconceptions About Dividing Fractions Based on Kolb's Model." *Thesis*.Dubai : The British University.

Arsyad, Azhar. 2013. *Media Pembelajaran*. Jakarta : PT GrafindoPersada.

Bandler, R. and Grinder, J.. 1979. *Frogs into Princes*. Moab Real: People Press.

Barbe, W.B. and Milone, M. N.. 1981. "What We Know About Modality Strengths." *Educational Leadership.*

Felder, R. M.. 1989. "Meet Your Students. 1. Stan and Nathan."*Chemical Engineering Education*, Vol. 23, No. 2.

Felder, R. M.. 1993. "Reaching the Second Tier: Learning and Teaching Styles in College Science Education." *J. College Science Teaching*, Vol. *2*, No. 5.

Felder, R. M. and Silverman, L.. 1988. "Learning and Teaching Styles in Engineering Education." *Engineering Education*.

Felder, R. M. & Brent, R.. 2005. "Understanding Student Differences." *Journal of Engineering Education*, Vol. 94*2*, No. 1.

Ibrahim M & M. Nur. 2000. *PembelajaranBerdasarMasalah*. Surabaya: UNESA-University Press.

Kolb, D.. 1984. *Experiential Learning: Experience as the Source of Learning and Development*. Prentice-Hall: Englewood Cliffs.

Kunandar.2007. *IlmudanAplikasiPendidikan*. PT Intima

Lawrence, G. D.. 1993. *People Types and Tiger Stripes: A Practical Guide to Learning Styles*, 3nd Edition. Gainesville: Center for Applications ofPsychological Type.

Ratumanan. 2002.*PembelajaranBerdasarkanMasalah*. Jakarta: Ghaliaindonesia

Sudjana.Nana. 2002. *Dasar-dasar Proses BelajarMengajar*. Bandung :SinarBaruAlgesindo.

SuyonodanHariyanto. 2011. *BelajardanPembelajaranTeoridanKonsepDasar*. Bandung: PT RemajaRosda.

Woolfolk, A.. 2009. *Educational Psychology Active Learning Edition*.Yogyakarta: PustakaSiswa.

OPTIMATION ANALYSIS OF AMMONIA CONTENT
IN THE ELECTROLYSIS METHOD USINGCARBON ELEKTRODE

Muflihah, Rexy Anderson Tindangen, Nova Adelia Noor
Chemistry Education, Faculty of Teaching & Education, Mulawarman University, Samarinda

ABSTRACT

Hydrogenis a source ofalternative fuel which can be sustained.It is clean fuel since it burning residue is water.One method to obtain hydrogen is water electrolysis, but it is highly cost.Alternatively, hydrogen can be obtained by ammonia electrolysis using carbon electrode.

This research was experimentally design to find the most optimum electrical current and KOH concentration in ammonia content analysis using carbon electrodes.

Based on the data results, it is concluded that current variationin the elektrolysis using carbon elektrodesdirectly proportional toward ammonia conversion level. As the current increase, more ammonia converses.On the contrary, variation of concentration is inversely proportional toward ammoniaamount.

I. INTRODUCTION

Other than limitation in availability, the using of fossil fuel has an adverse effect to the environment.High carbon dioxide emission gives a huge contribution to the global warming. Natural devastation during the exploitation is another way of fossil fuel negative impact.In general, exploitation anduse of natural energy resources to fulfill human needs will always create negative impact to environment.

Recently, people are trying to find an alternative source of energy which is clean and environmental friendly. One of promising source is hydrogen. In fact, the combustion of hydrogen obtains water as ‘residue’.It sounds great fuel, but the source and processing technology still in question. So far, hydrogen is produced with two methods, which are steam reforming methanegas method andwater electrolysis method. However, steam reforming methanegas processcould produce waste gas CO, CO_2, and H_2S; while water electrolysis is not efficient since it needs high electrical current which means highly cost.

Based on this situation we try to find solution on how to produce hydrogen with electrolysis method using alternative raw material. From the references, theoretically it is possible to produce hydrogen from ammonia. Many researchers are found the appropriateness of electrolysis to overcome waste ammonia. However, they used rare electrodes. In this study, we try to use inert electrode and easy to find daily.

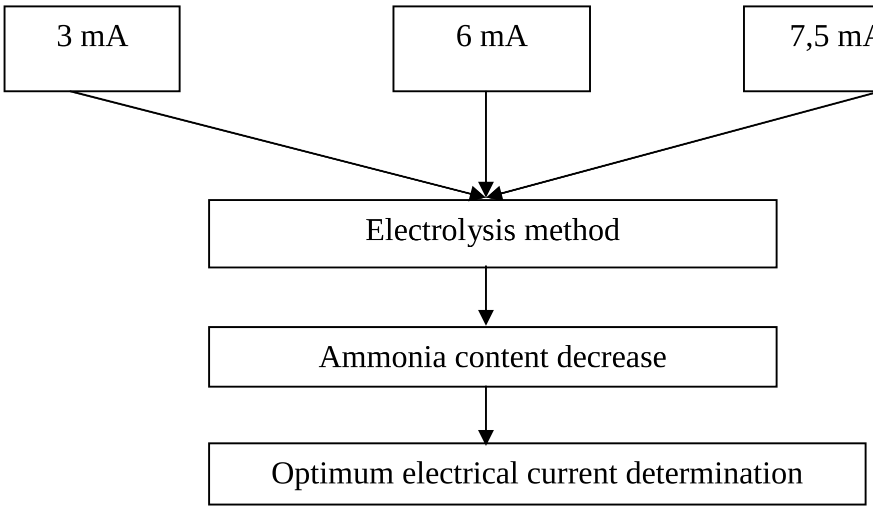
II. RESEARCH METHODOLOGY

1. Natrium tetra borate standard solution

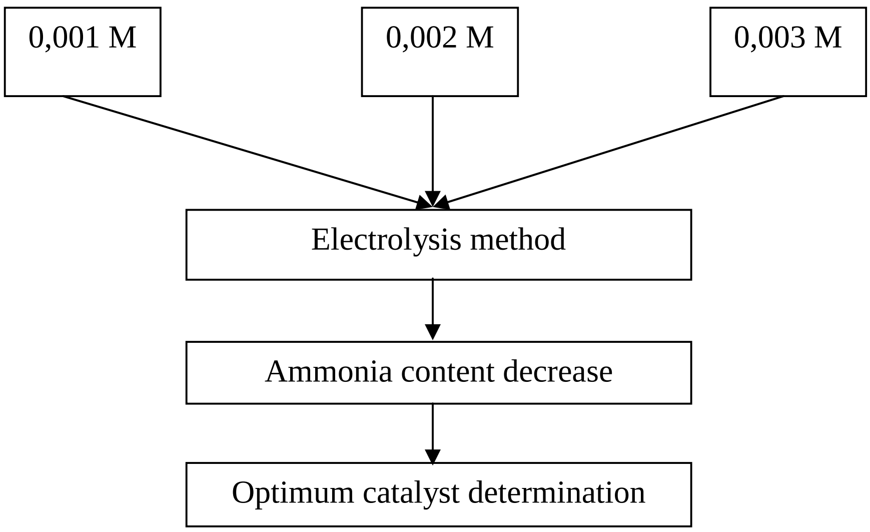
   Weigh 9,4 gram Natrium Tetra Borat, put in the 500,0 mL volume flask, add with aquadest at about 100 mL and adjust until the markreached.
2. StandardizeHClsolution with natrium tetra borat using indicator color change from yellow to orange (from base to acid). Find the HCl volume used.
3. Sample electrolysis

Put titrated sample into 1000 mL beaker glass

Variation of the pure ammonia electrical current using electrolysis method



Variation of the KOH (catalyst) concentrationin the pure ammonia using electrolysis method



III. RESULT ANDDISCUSSION

A. Result

Below are result observation on the effect of electrical current variation on ammoniaelectrolysis:

1. Recapitulation of NH_3 concentration after electrolysis using three electrical current variations

Electrical Current	NH_3concentration
3 V	37,5 ppm
6 V	29,5 ppm
7,5 V	20,5 ppm

2. Recapitulation of NH_3 concentration changeson three electrical current variations

Electrical Current	NH_3concentration changes
3	12,5 ppm
6	20,5 ppm
7,5	29,5 ppm

3. Recapitulation of NH_3percentage conversed after electrolysed using electrical current variations

Electrical Current	Percent NH_3 conversed
3	25 %
6	41 %
7,5	59 %

4. Recapitulation of KOH(catalyst) concentration variationusing threeelectrical current variations

Tegangan / KOH	3	6	7,5
0,01	7,5	5,9	4,1
0,02	4,3	3,9	3,8
0,03	4,1	4,0	3,7

B. Discussion

This study aimed to understand the effect of electrical current variation and KOH (catalyst) concentration variation on ammonia content after electrolysisprocess. We used ammonia solution with concentration of 50 ppm. Electrolysis was run for 2 minutes with 3 different current (3V, 6V dan 7,5 V) and 3 KOH (catalyst) concentration (0,01 M, 0,02 M and 0,03 M).These electrical current variation refer to the power supply capacity used in this study. We usedcarbonelektrode from dry battery.

Theoretically, reaction in each electrode is as follow:

$2NH_{3(g)} + 6OH^-_{(aq)} \rightarrow N_{2(g)} + 6H_2O_{(l)} + 6e^-$ $\quad E^0 = -0,77$ V/SHE

$6\ H_2O\ (l) + 6e^- \rightarrow 3H_2(g) + 6OH^-_{(aq)}$ $\quad E^0 = -0,83$ V/SHE

While standard potential of cell in these two reactions are measured from reduction potential standardminus oxidation potential standard, i.e:

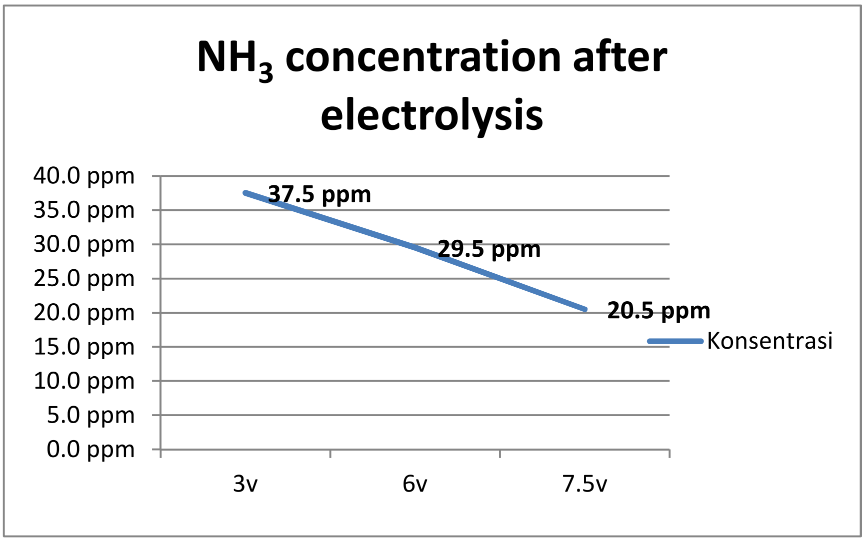
$2NH3(l) \rightarrow N2(g) + 3H2(g)$ $\quad E^0 = -\ 0,06V$

Theoretically, the E value is the minimumcurrent needed to ensure the ammonia electrolysis reactionmighthappen. In fact, to determine the needed current is depend on overpotentialfactor. The overpotential is divided into 2 kinds, consentrationoverpotential andactivation overpotential. Consentration overpotential relate to interactionbetween sample and electrode surface. Activation overpotential related to resistance from the electrode. To overcome consentration overpotential, we used magnetic stirer during the electrolysis so the sampleand electrode are maximally interacting. Whereas to determine activation overpotential, it refers to others study. To determine the current need in this study is using formula:

$$E_{needed} = E_{anode} - E_{catode} + iR + \omega_{catode} + \omega_{anode}$$

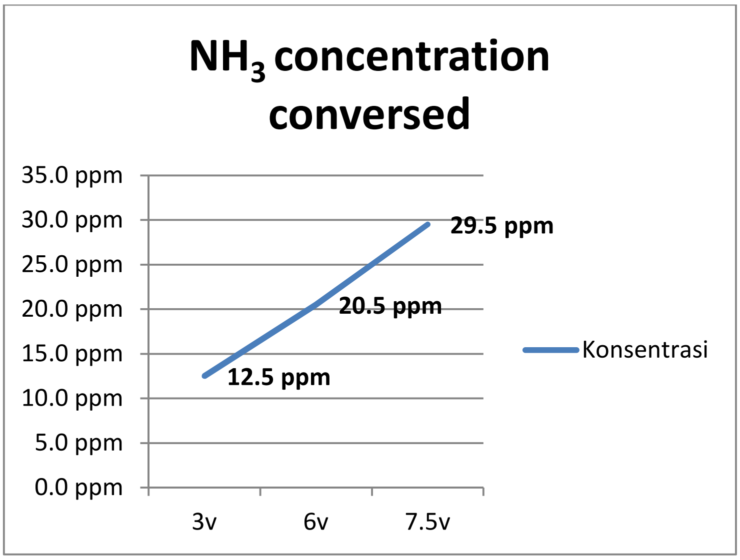
From data analysis, we found that minimum current needed in this electrolysis reaction is 0,09 V.

Ammonia concentration after electrolysis using current variation tends to decrease, in other words it inversely proportional to current variation.It means,the ammonia concentration after electroysis process decrease if the current increase. This can be seen in Graphic 4.1..



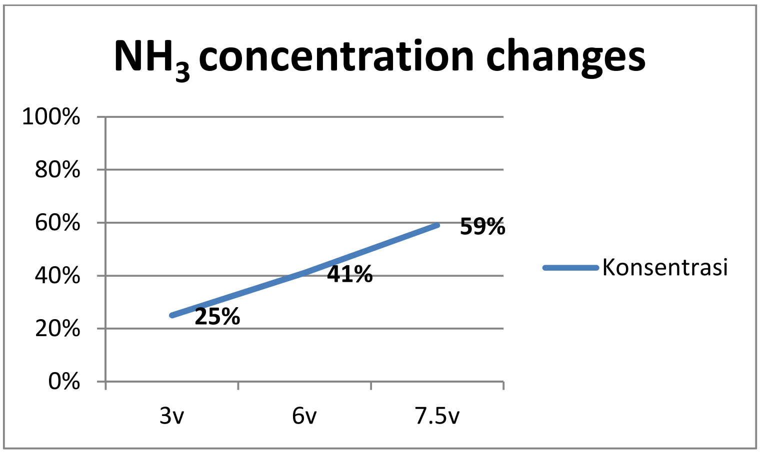
Grafik 4.1. NH_3concentration after electrolysisprocess

If we see from conversed ammonia amount, as the current increase more the ammonia conversed. In other words, the ammonia concentration conversed is directly proportional to the used current.This conversion ammonia concentration is depicted inGrahic 4.2.



Graphic 4.2. NH_3concentration changes

The percentage ofconversed ammonia can be seen inGraphic 4.3.



Graphic 4.3. Percentage NH_3Concentration changes

This trendcan be explained using the first law of Faraday: “the amount of substance produced or dissolved during the electrolysis (G) is directly proportional to the quantity of charge flowing through thecell (Q)”. Matematically, this relation can be written into:

$$G \sim Q$$

Electric charge (Q) has direct correlation to electric current (i), whereas this relationship can be depicted as:

$$Q = I \times t$$

where:

Q = electric charce

I = electric current

t = time

From this equation, we can see electric current (I) directly proportional to electric charge (Q). It means if the electric current increase, then the electric charge will increase too.

Electrical current (I) also havedirect correlation to voltage (V) as depicted in the equation:

$$V = R \times I$$

where:

V = voltage

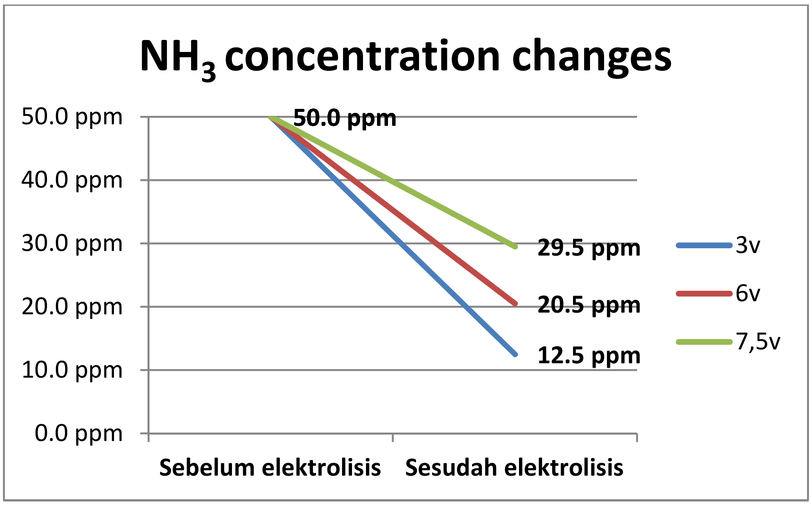
R = resistance

I = current

Electrical current (I) is direct proportionally with voltage (V), which means if the voltage increase, then the current also increase.

Refer to this equation,it can be conclude that the quantity of conversed matter in the electrolysis process is direct proportionally to the voltage used in the process. Consequently, if the voltage increases, the conversion of matter also increases.In this study, the highest ammonia conversion was happened at voltage of 7.5 V andthe lowest was at 3 V.This is also explaining why the trends of ammonia conversion following the trend of voltage increase.Visually, this trend is also can be observed from the bubbles produced during the process. The higher the voltage applied, more bubbles were produce.These bubbles were gas obtained from conversion, which are hydrogen and nitrogen.

Graphic 4.4.explains the effect of voltage variation(3 V, 6 V and 7,5 V) to ammonia concentration after electrolysis.



Grafik 4.4. NH_3concentration changes before and after electrolysis

Based on graphic 4.4, we can see that the smallest conversionhappened at voltage of3V andthe greatest conversion at 7,5 V. It shows that thehigher current is used, the more ammonia converse.

Other than first Faraday law, this conclusion also supported by Riwayati (2010).The difference between her study and this study is on the variable of effect. Riwayati measured the impact on current density. She concluded that ammonia conversion direct proportionally tocurrent density(J). Current density(J) is comparison ofelectrical current (I) percross-sectional area (A). Theoretically, the relation between current densityandelectrical current can be shown as:

$I = J \times A$

Where as:

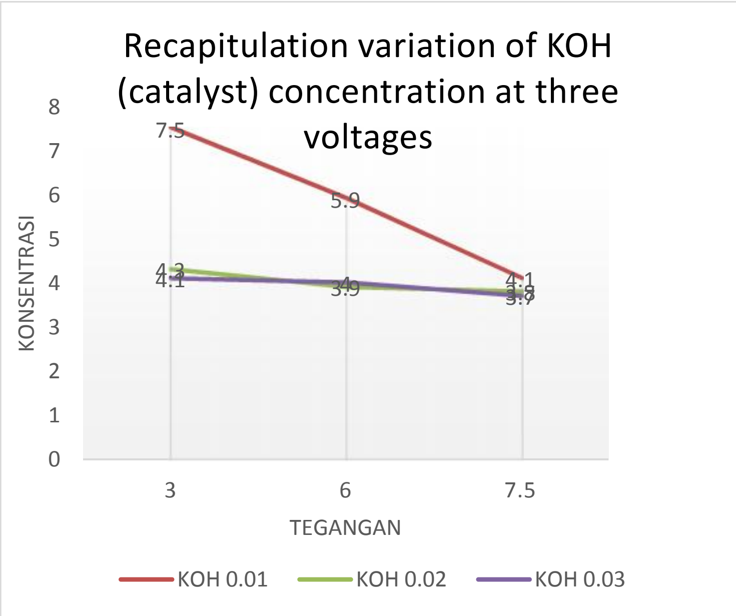
I = current

J = current density

A = cross sectional area

From the equation above we can see that current value is direct proportionally tocurrent density. It means if the current increases, then the current density also increase. Current value also direct proportionally to electrical charge. In this case, increasing the current density causes direct proportionally to ammonia conversion.

Different from trend on voltage changes above, variation ofKOH (catalyst) concentrationshows the adverse effect. It is inversely proportional to the increase of voltage. As theconcentration of KOH increase at certain voltagethe amount of ammonia obtained was lesser.



From the graphic above, increasing of KOH concentration as catalyst has no impact on ammonia yielded. At voltage of 3 V, it produced high ammonia but when it tried with some KOH concentration, the same result shows at about 4 ppm with voltage 7.5 V. Thus, any concentration of KOH added as catalystwill stableat 7.5 V. If we intend to get higher ammonia concentration, compare to those of three variations, then KOH 0.01 M should bepreferred as it yields ammonia 7.5 ppm.

Ammonia conversionis interesting research topic.The principle of ammonia conversioncan be applied to overcome ammonia waste problem in some home industries such as tofu or public toilet. In addition, hydrogen as a product of electrolysiscan be used as a source of environmental friendly biofuel. It is a matter of fact that hydrogen burning produces pure water (H_2O).

IV. CONCLUSSION

Current variation during electrolysis usingcarbon elektrode is direct proportionally to degree of ammonia conversion. The higher electrical current, more ammonia conversed. To obtain maximum ammonia, the KOH addition as a catalystis preferred atconcentration of 0.01 M.

Through electrolysis process, the ammonia waste can be reduced as well as obtain a new renewable source of energy.

V. BIBLIOGRAPHY

Assumpção, Monica. H. M. T., dkk. 2014. *Direct ammonia fuel cell performance using PtIr/C as anode electrocatalysts*. INTERNATIONAL JOURNAL OF HYDROGEN ENERGY. **Volume 39**. Hal. 5148 – 5152

Bonnin, E. P., 2006, *Electrolysis of Ammonia Effluents : A Remediation Process with Co-generation of Hydrogen*,Master Thesis, College of Engineering andTechnology of Ohio University, pp. 17-26.

Botte, G.G..2006. *Recovery of Ammonia Energy from Municipal and Agricultural Wastewater: Ammonia* . Colorado : Ohio University.

Brett, C. M. A. and Brett, A. M. O., 1993, *Electrochemistry : principles, Methods,and Applications*, Oxford University Press Inc., New York, Hal. 326-328.

Brigden, K. and Stringer, R. 2000, *Ammonia and Urea Production : Incidents ofAmmonia Release From The Profertil Urea and Ammonia Facility, BahiaBlanca, Argentina*, Greenpeace Research Laboratories, Departement ofBiological Science University of Exeter, UK.

Cheddie, Denver. 2012. *Ammonia as a Hydrogen Source for Fuel Cells: A Review*. Hydrogen Energy – Challenges and Perspectives.**Chapter 13**. Hal. 333-358

Chen, J., Shi, H., Li, J., 2007, Electrochemical Treatment of Ammonia in Wastewater by RuO2-IrO2-TiO2/Ti Electrodes, *J Appl Electrochem*, 37, 1137-1144.

Cooper, M., and Botte, G. G., 2006, Hydrogen Production from the Electro-oxidation of Ammonia Catalyzed by Platinum and Rhodium on Raney Nickel Substrate, *Journal of The Electrochemical Society*, 153, (10) A 1894-A1901.

Halliday, David dan Resnick, Robert. 1996. *Fisika Jilid 2 (Terjemahan)*. Edisi Ketiga. Jakarta: Erlangga

Hanada, Nobuko, dkk.2010. *Hydrogen generation by electrolysis of liquid ammonia*. The Royal Society of Chemistry, tahun 2010

Kim, K. W., Kim, Y. J., Kim, I. T., Park, G., Lee, E. H., 2006, Electrochemical Conversion Characteristics of Ammonia to Nitrogen, *Water Research*, 40, 1431-1441

Ratnawati, dkk. 2010. *Konversi Elektrokimia Amonia Menjadi Hidrogen*. Jurnal Teknik Universitas Diponegoro . **Volume 31** . Nomor 2 . Tahun2010. Hal.99

Riwayati, Indah, 2010. *Waste To Energy : Recoverydan Electrolisa Amoniadari LimbagPabrik Pupuk Untuk Menghasilkan Gas Hidrogen*. Momentum.**Volume 6** . Hal. 27 - 32

Robinson, James W, Eileen M. Skelly Frame, George M. Frame II. *Undergradute Instrumental Analysis 6th Ed*. 2005. Marcel Dekker: New York

Seran, Laurensius E. 2012. *HUKUM FARADAY*. Handout Workshop PPG (Pendidikan Profesi Guru). Universitas Negeri Malang Fakultas Matematika dan Ilmu Pengetahuan Alam: Malang

Sugiura, Kimihiko, dkk. *Optimization of Hydrogen Production by AmmoniaElectrolysis*. Osaka, Jepang : *Osaka Prefectural Coll of Technology*

Sukardjo. 2002. Kimia Fisika. Jakarta: Rineka Cipta

Sutrisno dan Tan Ik Gie. 1983. *Fisika Dasar*. Bandung: Penerbit ITB

Villano, Marianna, dkk. 2013. *Carbon and nitrogen removal and enhanced methane production in a microbial electrolysis cell*. Biosource Technology. **Volume 130**. Hal. 366 – 371

Vitse, F., Cooper, M., Botte, G.G., 2005, On The Use of Ammonia Electrolysis for Hydrogen Production, *Journal of Power Sources*, 142, 18-26.

Wang, Yaning, dkk. 2012. *Efficient Electrochemical Removal of Ammonia with Various Cathodes and Ti/RuO$_2$-Pt Anode*. Open Journal of Applied Science. **Volume 2**. Hal 241-247

Yan, L., Liang, L., Goel, R., 2009, Kinetic Study of Electrolytic Ammonia Removal Using Ti/IrO2 as Anoda Under Different Experimental Conditions, *Journal ofHazardous Materials*, 161, 1010-1016.

Yu, Cai-Hong, dkk. 2012. *Isolation and Identification of Ammonia Nitrogen Degradation Strains from Industrial Wastewater*. **Volume 4**. Tahun 2012. Hal. 790

Zhou, L., Cheng, Y. F., 2008, Catalytic Electrolysis of Ammonia On Platinum In Alkaline Solution for Hydrogen Generation, *International Journal ofHydrogen Energy*, 33, 5897-5904.

Zöllig, Hanspeter, dkk. 2015. *Inhibition of Direct Electrolytic Ammonia Oxidation Due to a Change in Local pH*. Electrochimica Acta. **Volume 165**. Hal. 348 – 355

AN ANALYSIS OF SCIENCE LITERACY SKILL FOR STUDENTS THROUGH GUIDED INQUIRY ON COLLOID SUBJECT AT XI GRADE IN SAMARINDA

Iis Intan Widiyowati
Department Chemistry Education, University of Mulawarman
iisintanw@gmail.com

ABSTRACT

The effort in developing science literacy for students can be done through the process of learning science. This process gives changes for students to embrace science completely, instead of teaching science only based on information. Solving the problem of topic discussion will be the design of learning process. Within this process, it needs a model that facilitates students to get a maximum meaningful learning that also involves students' participation in learning process. Wenning (2007), in his journal *Assessing Inquiry Skills as a component of Scientific Literacy*, stated that the skill of science literacy can be discovered through measuring students' inquiry skill. In this topic, inquiry skill means the ability to investigate. The results of the research above show that guided inquiry learning model is able to give positive influence to students' science literacy. This research used a qualitative descriptive method. The aim of this method was to discover fact, situation, variable and phenomena that encounter while analyzing a research and representing it as the way it was (Notoatmojo, 2012). In this research, the researcher used a descriptive design to delineate the fact or certain population characteristic systematically, factually and accurately in order to know the students skill in science literacy. The data collection technique in this research was a qualitative data gained from written test, interview, and documentation. The average percentage of students' science literacy in three domains (content, context and process) includes in good category. Achievement percentage in the content domain by 71.50%, context domain by 67% and process domain by 84%. It is relevant to Ibrahim & Aspar (2006) that there was a relationship between knowledge and application of science. Thus the high of one of science literacy domain will affect other science literacy domain. Judging from the aspect of content percentage of 71.50%, which means mastery of the concepts of science (colloid chemistry) is good. Judging from the aspect of student science content, it is obtained achievement by the percentage of 64%. This indicates that colloid chemistry learning has been linked with students' everyday real life.

Keyword : Science Literacy, Guided Inquiry

INTRODUCTION

The benefit of learning science can be achieved if the students have good science literacy. Science literacy is composed by two words, which are literacy and science. PISA (2004) stated that science literacy is an ability to use science, i.e. identify question, and conclude it based on evidence in order to understand the characteristic of science as a scientific identification. The nature of measurement in science literacy is multi-dimension including science content, science process, and contextual application.

Unfortunately, teachers' attention in developing students' science literacy is inadequate. In 2009, a research about science literacy put Indonesia in the rank of 57 from 65 countries. This research showed that Indonesia is in the below average (PISA, 2010). Meanwhile, in 2012 Indonesia got the rank of 64 from 65 countries (OECD, 2013). Hopefully, by using science literacy, students can become a citizen who capable to understand science, to have good skill and able to deal with science problem that encounter in daily life.

The effort in developing science literacy for students can be done through the process of learning science. This process gives changes for students to embrace science completely, instead of teaching science only based on information. Solving the problem of topic discussion will be the design of learning process. Within this process, it needs a model that facilitates students to get a maximum meaningful learning that also involves students' participation in learning process. Wenning (2007), in his journal *Assessing Inquiry Skills as a component of Scientific Literacy*, stated that the skill of science literacy can be discovered through measuring students' inquiry skill. In this topic, inquiry skill means the ability to investigate. The results of the research above show that guided inquiry learning model is able to give positive influence to students' science literacy.

There are several phases of guided inquiry learning. The first step is to formulate the problem. Teacher gives problem or question to students that later on will be solved by them under teacher's guidance intensively. After the problem being revealed, students develop a hypothesis that later on will be tested. In this phase, students are demanded to develop their skill in constructing a hypothesis. After making a hypothesis, the next step is collecting data from experiment and literature review. Students then analyze the data from the result of data collection. The last phase is to draw a conclusion from materials that being learned. Based on the guided inquiry learning above, it can be concluded that guided inquiry learning is a model that can be used to exercise students' literacy in science. These learning phases create scientist skill which directly implementing a critical thinking.

Based on Curriculum of 2013, students should understand the core of competency known as *Kompetensi Inti (KI)* in every educational level. The core of competency is elaborated in basic competency known as *Kompetensi Dasar (KD)*. In senior high school student of XI grade, the students' basic competency is to analyze the nature of Colloid and its application in daily life. For example: light scattering from car's light at night, the sunlight pass through tree leaves at foggy dawn, colloid in hairspray, and etc. Based on the above examples, students are trained to examine the current phenomena.

Colloid, as the student's main subject, provides facts about daily life activity that eventually demand students to develop activeness, skills, and also develop critical thinking in order to understand Colloid's material. Therefore, through comprehending colloid's material using inquiry process shows a scientific literacy that gives students ability to understand science in nature or to investigate surrounding phenomena. The guided inquiry process poses several phases that allow students to find the core concept of science content. After that, to see students' contextual science, we can see their capability on how students applied their knowledge to face the problem or phenomena that happened around us. Based on this, the researcher is interested to conducting a research with the title of “An Analysis of Science Literacy Skill for Students through Guided Inquiry on Colloid Subject at XI Grade In Samarinda”.

RESEARCH METHOD

This research used a qualitative descriptive method. The aim of this method was to discover fact, situation, variable and phenomena that encounter while analyzing a research and representing it as the way it was (Notoatmojo, 2012). In this research, the researcher used a descriptive design to delineate the fact or certain population characteristic systematically, factually and accurately in order to know the students skill in science literacy. The data collection technique in this research was a qualitative data gained from written test, interview, and documentation. In qualitative research, human was the main instrument. Therefore it needed crosscheck to know the validity of the data. To test the credibility of the data, the researcher used triangulation technique. The technique of triangulation was to select the data with different ways and method, cross over the information so then the data was expectedly comprehensible. After gaining data saturation which was unrepeated data, these data then will be credible. In a theory, Sugiyono defined four kinds of triangulation which were using data, method, investigator, and theory of triangulation.

RESEARCH FINDING AND DISCUSSION

Data collection technique was obtained by a test and non test (documentation and interview/open question). In giving the test, there were two techniques to conduct these. First, the researcher gave the students written test consisting of reasoning multiple choice in order to measure the content domain and context domain in students’ science literacy. Second, students would analyze an article in order to measure the process domain using a rating scale as scoring rubric. In scoring the students’ analysis, the researcher would give check (✓) based on scoring rubric criteria. Besides the test techniques, there were also two techniques of non test; they were documentation and interview/ open question. Documentation in this case consisted of post test result and students’ worksheet known as *LKS (Lembar Kerja Siswa)*. The post test that always distributed at the end of classroom meeting was an additional data for content domain and context domain. Meanwhile students’ worksheet which was filled by students during the learning process became an additional data to measure science process domain. Moreover in interview / open question, the researcher used impromptu topic that would be adapted through surrounding. The aim of this topic was to explore students’ content domain in science. The result of each student science literacy skill as followed:

1. **Students’ skill in content science**

   Science content basically based on science concept which comprehending the nature phenomena and its change in nature. In this case, PISA did not limit specifically the scope of science content only for scientific knowledge used in school’s curriculum, but this scientific knowledge was also the knowledge that was gained from other sources. In this research, the data of content domain was obtained through a test for sample students and acquiring post test at the end of classroom meeting. Below was the diagram of students result based on content science domain:

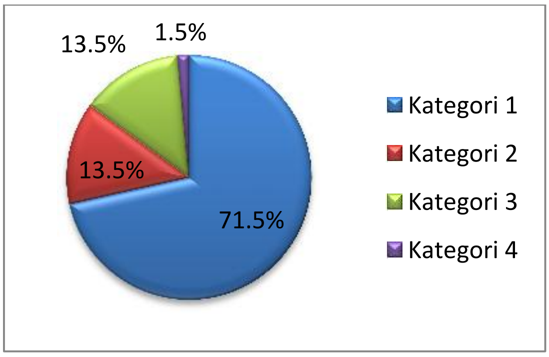


Figure 4.1. The percentage diagram of students result in content science domain

Based on the diagram above, the percentage of students answer in category one was 71,5 %. This showed that students had comprehended the concept correctly and completely. In the category two was 13,5 % which showed students' partial comprehension or misconception, in category three was 13,5 %. This also showed that students had partial comprehension because students were not able to conclude the concept, and in category 4 is 1,5 %. This showed that students did not have a good concept of comprehension or in other words they did not understand the material. Based on the science content of students above, in category 1 part of students (71,5%) had good/ high comprehensive theory. This situation emerged because students understood the concept of colloid completely, so then students were able to answer and to establish reasoning correctly. This comprehension delineated a capability to connect the relation between cause-effect or vice versa. A good comprehension would accelerate the science process and students' creative thought in solving problem. They faced the problem better, and then their chemist result would be better too. In category 2 which was 13,3 % showed that only part of students owned the average comprehension. Students were able to answer the multiple choices correctly but failed to interpret the reasoning on the selected choice. This situation created by several things such as neglecting the basic concept of colloid, wrong perception in comprehending theory, and a failure of connecting the old concept and new concept. Actually, between these concept (old and new one) had a connection as a whole concept. In category 3 which was 13,5 % showed that part of student owned a partial conception or in other words an average comprehension. Students who had this partial conception could only state the concept without generalizing the concept correctly. They could not draw a general conclusion or a general terminology of colloid concept. As a result of this, students were only capable to post reasoning correctly but incorrect in answering the multiple choices. In category 4 which was 1,5 % showed that little amount of student had very low conception in understanding the material. Students faced difficulties in understanding the material. This situation emerged because the students could not adapt to the learning model. Students preferred to be passive in learning the material.

Besides that, the cause of this circumstance could be derived by different model of perceiving the material. Perhaps, there was an auditory student who learned the material by listening instead of doing an activity. Because of unmatched learning model, students were not able to gain material correctly.

2. Students' skill in contextual science

Contextual science basically derived from the application process and comprehending science concept in daily life. The measurement in this contextual domain was written test of multiple choice reasoning and interview / open question that connected in daily activity.

Below was the diagram of students result based on contextual science domain:

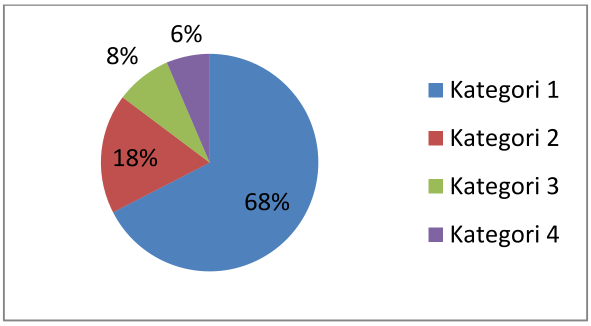


Figure 4.2 The percentage diagram of students result in contextual science domain

Based on the diagram above, category one had percentage of 68 % from total students. This showed that in category one mostly the students had good contextual skill. This situation emerged because students were able to connect the facts with the concept that they owned. They easily perceived the material through a direct observation using senses. This situation showed that most students still depended on concrete examples especially in introducing new ideas. But, somehow the experience in obtaining the concrete examples would help science learning process. However these examples could be applied if they were relevant with structural conceptual context. Slowly but sure, using students' experiences, they would develop students' comprehension in understanding abstract notions, manipulating math symbols, thinking logical, and doing generalization. In category 2, part of students which was 18 % of them showed that they owned partial conception. This situation happened because students had limited conception in connecting the concept of theory with daily experiences. For example, students could not explain or connecting the correlation between cause and effect that encounter in general phenomena correctly. Therefore, this circumstance made the students choose the correct answer in multiple choices but failed to interpret the reason of choosing that choice. In category 3, there were 8% of little amount of students who owned the partial conception. This partial conception raised difficulties for students to create a generalization in certain circumstances of daily life. Based on these difficulties, students failed to interpret the concept or the general conclusion of certain phenomena precisely and correctly. In category 4, it obtained 6% from total students. This percentage showed little amount of students who owned the lowest level of contextual skill. The cause of it was the students' difficulties or misunderstanding in receiving the concept; therefore, students could not apply that concept. Besides that, the students' discomfort on certain learning method could create difficult process in receiving the material. To help students dealing with their difficulties, remedial learning can be used to cover it. After that, we could see whether the mistakes would reappear or not. Students' mistakes in this case were divided into two aspects, i.e. conceptual mistake and procedural mistake. If the conceptual mistake emerged, this situation could be handled by teaching again the theories or the formulas that have been learnt. In re-teaching the material, the researcher would use different type of learning process. In the other hand, procedural mistake is a mistake that located in stage of identifying the question, analyzing the question, and giving a solution according to the question. This mistake could be solved by doing the question or the problem all over again. But this time, students should focus on facts, concepts, and principles that have been learnt. The learning process of procedural mistake would use different type of method too. To measure students' skill in contextual science, the researcher gave a comprehensive interview to several students who directly involved in teaching process using this guided inquiry learning. The interview consisted of five issues with each issue had three basic questions. The issues were correlated with natural phenomena of surrounding. These issues demanded students to deal with common problems that encountered in learning process.

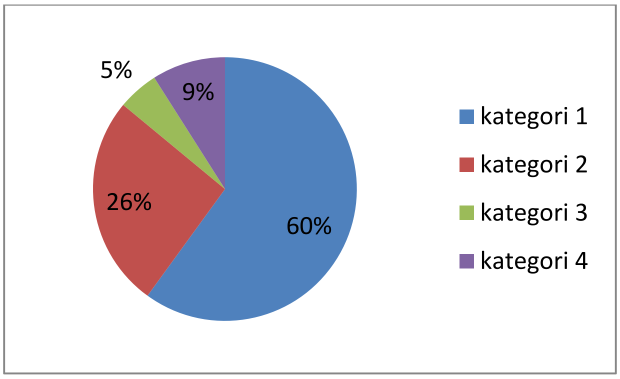


Figure 4.3 The percentage diagram of students result in contextual science through interview

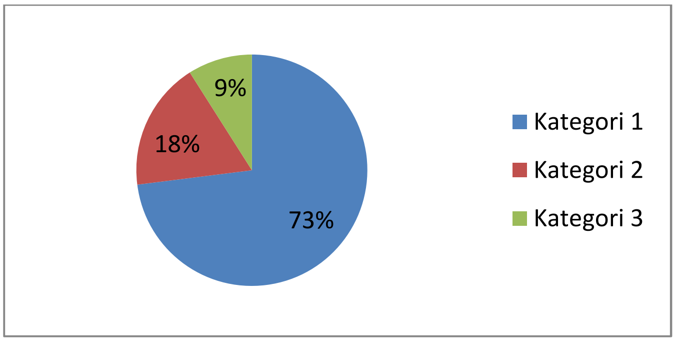
Based on the diagram above, it showed that percentage of students result in category 1 is about 60%. Most of students in this percentage were able to answer these three questions very well. In category 2 is about 26 % which delineated that almost half of the students capable in answering two basic questions. In category three is about 5%. This percentage showed that students were only able to answer one basic question. Meanwhile in category four, there were only 9% of students who could not answer all of the basic questions. Based on the data findings, it was about 60% of students who were included in category one. This indicated that most of the students had very good contextual science skill. In this category, students were capable to answer the basic questions correctly. The questions covered basic questions until the complex questions. The complex question covered questions about “What”, “How”, and “Why”. These correlated questions demanded students to explain the correlation of those questions with students’ material. This finding also supported by written test that showed 68% of students had a very good contextual science skill. Based on the calculation of data distribution, using Koentjaraningrat (1990) in Sulfyana (2004) theory, 51 % until 75 % is the average category. Based on these percentages, it could be concluded that contextual data derived from written test and interview supported each other. Moreover, the application of contextual science was influenced by students’ skill of science content. In other words, if the content domain was good then this also influenced students’ contextual skill. To prove this, the data had already shown that there was a relevancy between them. This notion is relevant with Ibrahim & Aspar research (2006) on how there was a correlation between science and its application. Based on both result of written test and interview, they showed that this guided inquiry learning could be perceived well to the most part of students and directly affected to students’ level of science literacy. In category two about 26% of total students showed that almost part of them answered only two basic questions. These questions were “what” and “how”. Students were not capable to answer the basic question of “why” that demanded students to explain the reason of given phenomena. This situation could be caused by several factors; one of them was low capability. Students who owned low capability would encounter difficulty in interpreting reasoning of certain fact. Furthermore, from five issues, there were 3 issues that never been used in teaching process. This situation created students’ difficulties in connecting the reasoning and concept of the material. And the result above was relevant with the written test percentage in contextual content. In the category 2 of contextual content, they were about 18% of students who could not construct a reason of given answer. The percentage of category 3 is about 5 % of total students. This category delineated that little amount of students had difficulties in constructing generalization between the phenomena and the concept. There were students who explained single phenomena with simple words. However they still could not make a correlated conclusion in their explanation. This situation indicated that students could answer the questions about “how and why” but failed to answer the question about “what”. The lack of memorizing the abbreviation or students’ incapability to tell the meaning of terminology, i.e. dialysis and electrophoresis, were the cause of students’ failure in answering the question about “what”. This result was relevant with the contextual science in category 3. In that category, it showed 8% of students were having difficulties in generalizing the material. In the last category which was category 4, the percentage showed 9% of students were not able to answer several issues that given by the researcher. This situation created by low capability that was owned by students in contextual skill. Students were having trouble in applying the given learning model. This data was supported by the result of contextual science that showed 6% of student in category 4 did not have contextual science skill.

3. Student Science Process Ability

Dimensional process includes science competency component. Science process refers to the mental process that involves when answering a question or solving a problem, such as identifying and interpreting evidence and explain conclusions. This includes knowing the types of questions that can and cannot be answered by science, knowing what evidence is needed in a science investigation, and knowing conclusion which is suitable with the available. Learners must be able to describe a clear and logical connection between the evidence and conclusions. As for the process of science inquiry is the science process that involves logical thinking ability, reasoning ability and critical analysis. The process of science inquiry is highly relevant to the nature of science (chemistry) as well as one of the characteristics in learning science. The literacy ability of students in the domain of science in the review process can be based on the ability of the student inquiry. Inquiry ability of students means the ability to investigate, where if students are directly involved in the investigation will make learning becomes meaningful. In this study, the domain data of science process was obtained from Student Worksheet and Articles. The following are data from science domain process on three aspects of competence:

a. Identifying Scientific Questions

Scientific questions are questions that demand answers based on scientific evidence, which also includes recognizing the questions that may be investigated scientifically in a given situation, seeking information and identifying key words and familiar features of scientific inquiry, for example, what things should be investigated, additional information what is required or what action should be done so that relevant data can be collected. In the aspect of identifying scientific questions are covering ability to file problem formulation, make hypotheses and collect relevant data. Here the percentage of students' ability in identifying aspects of scientific questions:

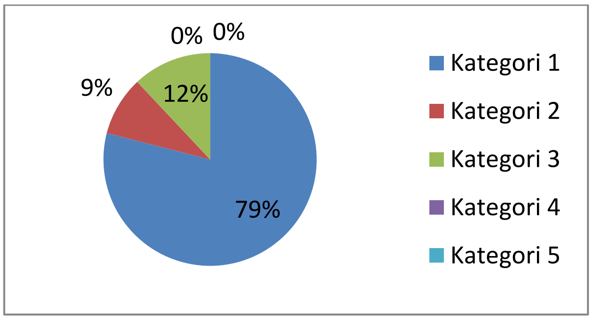


Picture 4.4. Diagram of science domain process percentage on identifying aspects of the student scientific questions overally

Based on the diagram above, the percentage of category 1 by 73% of the total number of students. This indicates that the vast majority of students have been able to identify scientific questions well. The ability to identify these covers in filing a problem formulation relevant to the topic of learning, making hypotheses correctly based on the formulation of the problems that have been proposed, and collecting data obtained completely. The ability in making a problem formulation is a stage to explore early knowledge of the students so the students interested and ready to follow in the learning process. At this stage the teacher invites students to pay attention to the reality that is happening around associated with the concepts that will be studied and stimulating the students by asking questions related to the concept. Percentage in category 2 of 18% illustrating that a minority of students in making a problem formulation is not relevant to the topic of learning, making the hypothesis does not correspond to questions and in doing collecting data have difficulty so the data that have been obtained is not complete. It may be caused the students have not accustomed in teaching and learning activities that whet students' critical thinking ability and students' science process ability. A small part of students are more accustomed to answering questions after learning rather than asking a question for something to be learned, as a result students have difficulty in exploring the nature of the student's curiosity that formed into the problem. In the third category of 9% of the total number of students shows that a small percentage of students does not make the problem formulation, hypothesis and do not perform ability in collecting data completely. It can be caused by several factors, including the lower ability of science content, where the ability of science content effects during the process; Low in context abilities, context abilities are required in analyzing and linking a phenomenon or fact with the concept of existing material, both in filing problem formulation, making hypotheses and collecting data.

b. Explaining Scientific Phenomenon

At this scientific explaining stage, the ability to explain phenomenon scientifically includes competence in applying science knowledge in a given situation, describing phenomena, describing the changes. In explaining scientific phenomena that have included some questions that lead students in describing the experimental results and the changes that occur in an experiment.

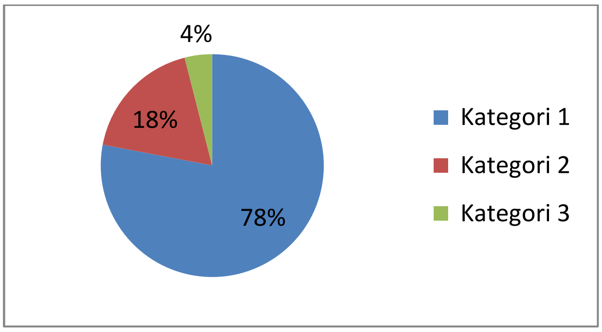


Picture 4.5. Diagram of science domain process percentage on explaining aspects of student scientific phenomenon overall at worksheet

Based on the diagram above, the percentage of students in category 1 by 79%, illustrating that most of the students have been able to answer all scientific questions on the article and worksheet correctly. Referring to the data, may indicate that the majority of students have been able to explain scientific phenomena based on observations and analysis that they explain through the questions on the measuring instrument is through student worksheets and articles they have observed through the questions on the worksheet. These questions are arranged in chronological order to help students gradually explain the fact of the data they have acquired based on observations and facts as a result of their analysis in an article. Based on these data, the ability to explain scientific phenomenon can be influenced by the content ability of the students very good because one of the factors that affect the ability of students to answer the problem is that the whole concept that has been stored in students' memory. These concepts are prerequisite knowledge to answer the question. In the second category of 9%, these data illustrate that there is a small of the number of students only can explain scientific phenomenon through the questions on the worksheet correctly around 75% of the number of questions that are filed. This can be due to difficulties in analyzing the questions and difficulties in linking the data that have been obtained with the material concept that is owned, so students can not provide proper explanation and are not able to give a logical reason of the question. In the third category of 12%, describe a minority of students only can explain scientific phenomenon from their experiment just only 50% or just a small part of the questions on the worksheet. This may be caused the students are good enough in terms of content and context of student science so that students have the 50% error in answering the questions that have been given. Errors in compiling the answers may occur because of errors in using the concepts that have been known to answer that question or concepts that were used are the wrong concepts that are understood by the students. In the fourth category is 0% and the fifth category is 0%. This shows that no one of the students included in this fourth category (25% answered correctly) and fifth category (not answered correctly at all). It may be caused the students have had the good ability of content and context, so the students are easy in answering some even whole question correctly.

c. Using Scientific Evidence

Using scientific evidence with connect a fact which has been obtained with a general conclusions that are correct and complete. In the aspect of using scientific evidence, it is very necessary concluded ability on students and concluded ability of the students strongly influenced by the current ability when collecting data and requiring the students to be able to understand the experiments that have been done.



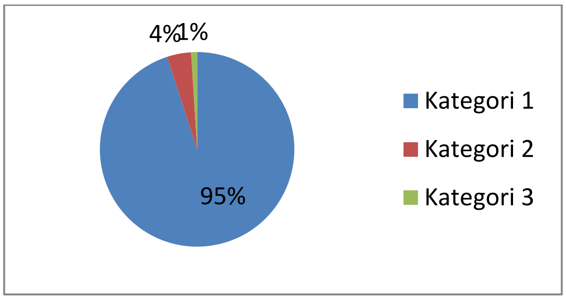
Picture 4.5. Diagram of science domain process percentage on using scientific evidence of students overall at worksheet

Based on the diagram above, there are 78% of the number of students included in the category 1 which shows that most of the students have been able to make a true and complete conclusions based on experimental results that have been obtained. This can be due to the students' ability in interpreting data on explaining scientific phenomenon aspect is very good as an idea that students can understand better the experiments that have been done, so the students can create general conclusion on the experiment more easily. In the second category of 18% of the total number of students shows that a fraction of the number of students has not been able to make general conclusions with correct and complete or only can make a conclusion on the certain data. This could be caused there are students who are still experiencing an error in interpreting the data that was obtained so that students have difficulty in making a correct conclusion on the interpretation of certain data. In the third category of 4% of the number of students shows that there is a fraction of the number of students experiencing difficulty in making a conclusion from the facts that was obtained. It can be caused by several factors, including the low capacity of the content and context that was owned by the students so the students experience the student errors in interpreting the data, it is also low ability students in connecting a conclusion with the interpretation of the data that was obtained. If it is connected to the previous aspects, such as identifying scientific questions aspect and explaining scientific phenomenon aspect, then students that are in average or lower on these aspects could be possible will have difficulty at the stage of making a conclusion because reference data that is needed to make the conclusions as a whole, correct and complete is not support. In addition, the negative attitude of students in applied learning models can also affect it. Students have the difficulty in each of the stages of learning model is applied, where the students are not familiar with the learning involve activeness of the students but students are more comfortable and easier to accept if the material is delivered only verbally.

At this stage of the assessment process of science students, not only did based on the data in the students' worksheet while doing practical work, but rather to supplement the required data to researchers, researchers using the reading material in the form of article number three pieces of articles that will be analyzed by the sample / students. The articles that are given to students are related to colloid chemistry that one of its articles titled colloid chemistry's role in the foodstuffs industry and beauty products industry. Then the questions are given in each article requesting answers to the analysis of students in each paragraph that is presented in the article. Similarly with worksheet, aspects that are measured on the domain of this process involve identifying scientific questions, explaining scientific phenomena and using scientific evidence. If previously the process domain is given when students do experiment where chemical abstract concept has been presented concretely so can be observed the changes directly, then it is different with this article. In this article, the students are presented the information that is still abstract or cannot be observed directly but still requires a process of thinking of students in analyzing carefully the information that was received. Through the analysis process is a process that the students do in increasing the science knowledge content and context of the students. On this analyzes article the student is required to understand the information that contained in paragraphs or reading comprehension, providing explanation and a logical reason of each question and connecting theme of the article with the chemical concept that has been owned by the students. Here are the results of the percentage of students in each aspect of the science process on the analysis of some articles:

a. Identifying Scientific Questions

At the aspect of this identifying scientific questions, measured by the ability of students to answer the questions at the article correctly. Students with the ability to answer the questions at the article in very good way that is properly then have the ability to identify scientific questions in good way to, this is caused if the students can answer the questions correctly then the students understand and are able to analyze problems / questions so well then the student is able to give the appropriate answer with the question. The following are the percentages on identifying scientific questions aspect:

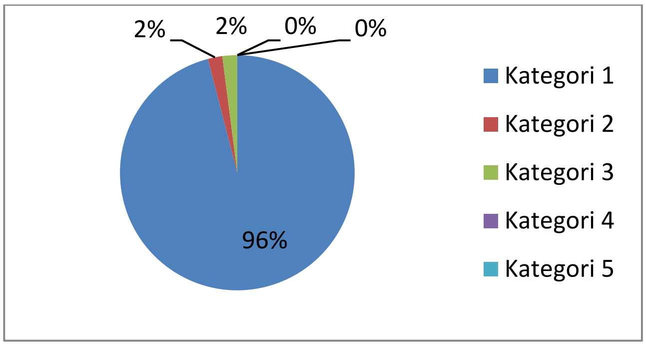


Picture 4.6. Diagram of science domain process percentage in identify scientific questions of the students on the article.

Based on the diagram above, the first category there is a percentage of 95%. It shows that almost all students have the ability to identify scientific questions well. This could be caused these students have the good science content where the content ability is very affected at this process stage, the information contained in the article can they associate with content ability of the students so happen a good association and cause the students can understand the meaning of the question that is filed. In the second category is percentage of 4%. This indicates that a fraction of the number of students to have the ability to identify scientific questions only in the average category. This is because students have difficulty in identifying or understanding of some questions. These difficulties can occur because students have the content ability is less, so that students have limitations in studying a question because the owned ability are limited too. In the third category is percentage of 1%, where there are no students in this category. This indicates that all students are able to use the content ability that was owned to analyze the questions on several articles.

b. Explaining Scientific Phenomenon

At the stage on explaining scientific phenomenon, students are required to be able to answer correctly the questions in some articles that are provided by the researcher. Ability to answer correctly the questions depends on the students' ability in understanding, analyzing reading article carefully and students' ability in providing a logical explanation and reason for the questions that are filed. The following are the percentages of the students' ability in explaining scientific phenomenon aspect:

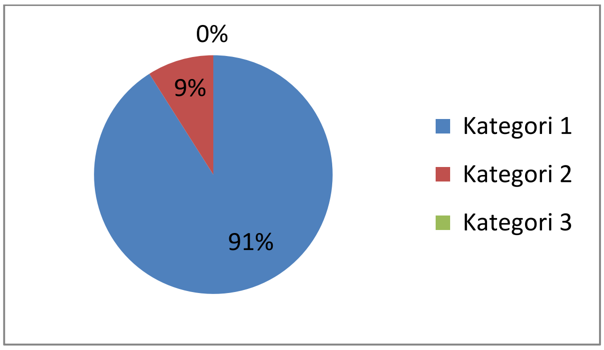


Picture 4.7. Diagram of science domain process in explaining scientific phenomenon aspect of the students on the article

In the first category there is a percentage of 95%. This indicates that most of the students are able to answer correctly to all questions. This is because the science content and context ability of the students are very good, and the students are able to link the theme of the article that is read with chemical concepts that previously learned, so the students are able to analyze a problem in the form of questions in the article and provide logical explanations and reasons of each question. Moreover, the nature of precision and high confidence is able to be a motivating factor for students to explain scientific phenomenon. Students with excellent accuracy can analyze literature well too which in this case is the colloid article. In the second category is percentage of 2% of the number of students. This indicates that a fraction of the number of students is only able to answer correctly the questions that range from 75% of the number of questions. This can be due to the level of science content and context ability, the nature of precision in analyzing and nature of self-confidence of the students is still below the ability of students in category 1, as a result of these students have difficulty in connecting several specific article themes with chemical concepts that previously learned and have difficulty in analyzing the questions that are considered difficult to understand. In the third category is percentage of 2%. This shows that there is 2% of the number of students or a fraction of the number of students that only able to answer correctly 50% of the questions that has researchers propose. It may be caused the students have lack in the content and context ability and have lack of the students' understanding to the information that is contained in the text, so the students feel it difficult to analyze and understand the meaning of some of these questions. As a result, students will also feel it difficult in finding the appropriate answers of the questions. In the fourth category is percentage 0% and the fifth categories is percentage 0%. This shows that no one of the students that included in this fourth category 4 (25% answered correctly) and fifth category (not answered correctly at all). It may be caused the students have had the good till fairly good ability of content and context, so the students have easiness in answering some even whole question correctly. If students are included in category 4 even category 5 it can be said that the ability of the science content and context of the students is very low. If it happens, then it is needed for a remedial or relearning about concepts of colloid chemistry material. Learning is implemented in a different way from the previous way.

c. Using Scientific Evidence

The ability using scientific evidence is a ability in making a conclusion based on the facts. In this article, students are asked to make a conclusion based on the questions that previously have been answered by the students as a representative on each of the information that is provided on a given article. Here the percentage of students' skills in using scientific evidence:



Picture 4.8. Diagram of the science domain process percentage of the students in using scientific evidence aspect on the article

Based on the diagram above, there is 91% of the number of students included in the category 1 which shows that most of the students have been able to make inferences correctly. This may be caused the students have a very good understanding of the content of reading material / articles they read, so they will more easily give a conclusion on each of the important information that is contained in the article. In the second category of 9% of the total number of students shows that a fraction of the number of students has not been able to make general conclusions correctly and completely or only able to make a conclusion on certain information. This can be due to the lack of reading comprehension of students to the article that is read, so it can be caused the students do not provide completely the important information that is contained in the article. In the third category is 0% of the total number of students illustrates that there are no students in this category. This is because students have the ability to conclude, as an illustration that the students have been taught how to make a conclusion..

CONCLUSION

The average percentage of students' science literacy in three domains (content, context and process) includes in good category. Achievement percentage in the content domain by 71.50%, context domain by 67% and process domain by 84%. It is relevant to Ibrahim & Aspar (2006) that there was a relationship between knowledge and application of science. Thus the high of one of science literacy domain will affect other science literacy domain. Judging from the aspect of content percentage of 71.50%, which means mastery of the concepts of science (colloid chemistry) is good. Judging from the aspect of student science content, it is obtained achievement by the percentage of 64%. This indicates that colloid chemistry learning has been linked with students' everyday real life.

REFERANCES

Alwi. H. 2007. *Kamus Besar Bahasa Indonesia*. Jakarta: Balai Pustaka.
Aunurrahman., 2009. *Belajar dan Pembelajaran.* Alfabeta bandung: Pontianak

Arikunto, S. 2004. *Dasar-Dasar Evaluasi Pendidikan*. Jakarta : Bumi Aksara

Arikunto, S. 2010. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta

Cecep E Rustana. (2002). *Manajemen Peningkatan Mutu Berbasis Sekolah. Buku 5 (Pembelajaran dan Pengajaran Kontekstual)* Jakarta: Direktorat Sekolah lanjutan Tingkat Pertama.

Daryanto dan Rahardjo,M., 2012. *Model Pembelajaran Inovatif*. Gava media: Malang

Dimyati dan Mudiono. 2006. *Belajar dan Pembelajaran*. Jakarta : Rineka Cipta

Echols, J. M. dan Shadily, Hassan. 2002. *Kamus Inggris-Indonesia.* Jakarta : PT Gramedia

Emiliannur. 2010. *Literacy Science*. Diakses 30 Januari 2015 dari http://emiliannur.wordpress.com/

Fitriani, W. Hairidan dan Ira L. 2013. Deskripsi Literasi Sains Siswa Dalam Model Inkuiri Pada Materi Laju Reaksi di SMAN 90 Pontianak. Pontianak: Pendidikan Kimia FKIP Untan

Holbrook, J. Dan Miia R. 2009. The Meaning o Scientific Literacy. *International Journal of Environmental & Science Education*.

Ibrahim & Aspar, Nor Hafiz. 2006. Tahap Literasi Sains Dalam Kalangan Pelajar Tingkatan Empat Sekolah Akhir Agam di Daerah Hilir Perak. Perak: UTM

Ibrahim, M. 2012. *Seri Pembelajaran Inovatif Konsep, Miskonsepsi dan Cara Pembelajarannya*. Surabaya: Unesa University Press

OECD. 2013. PISA 2012 *Result*. OECD

OECD-PISA. 2004. *Learning for Tomorrow's World*. USA: OECD-PISA

Oxtoby, dkk. 2001. *Prinsip-Prinsip Kimia Modern*. Erlangga: Jakarta

PISA. 2010. *Assessment Framework Key Competencies In Reading, Mathematics, and Science*. OECD

Roestiyah. 1998. *Strategi Belajar Mengajar.* Rineka Cipta : Jakarta.

Sanjaya, W. 2008. *Strategi Pembelajaran berorientasi Standar Proses Pembelajaran.* Kencana Pramuda Media Group : Jakarta.

Shwartz, Y., Ruth B.Z and Avi H. 2006. The use of scientific literacy taxonomy for assessing the development of chemical literacy among high-school students. *The Department of Science Teaching, The Weizmann Institute of Science, Rehovot, 76100,* Israel

Sudjana, N. 2002. *Penilaian dan hasil proses belajar*. PT remaja Rosdakarya: Bandung

Sukmariah dan Kamianti. 1990. *Kimia Kedokteran*. Binarupa Aksara : Jakarta

Thursinawati. 2012. *Penerapan Pembelajaran Inkuiri Terbimbing Untuk Meningkatkan Penguasaan Konsep Dan Pemahaman Hakikat Sains Siswa*. Juni 2012. Volume III Nomor 1. Banda Aceh. STKIP Bina Bangsa Banda Aceh

Toharudin,U. Dkk. 2011. *Membangun Literasi Sains Peserta Didik*. Humaniora: Bandung

Widoyoko, E.P. 2009. *Evaluasi Program Pembelajaran*, panduan praktis bagi pendidikan dan calon pendidik. Pustaka pelajar: Yogyakarta

Effect of Cooperative Learning Type Investigation Group (GI) Model With Experimental of Cognitive Learning Outcomes Environmental Science Education Study Program Biology

Sri Purwati
Fakultas Keguruan dan Ilmu Pendidikan, Universitas Mulawarman
Email: purwati 1126@yahoo.com

ABSTRACT

This study aims to determine the effect of learning model Group Investigation (GI) with the experimental method on cognitive learning outcomes of students. The study population was all students of biology education second semester, Academic Year 2014/2015. The sample in this study was determined by cluster random sampling technique consists of two classes namely class A (treatment) using Group Investigation learning model (GI) and class B (control). Data collection techniques using test techniques to get the data the cognitive learning. This type of research is a quasi experimental study. Design research in this study using a pretest-posttest design. Data analysis techniques in this study using statistical analysis techniques with separated variance t test. Cognitive learning outcomes the average value of class A (treatment) 78.09 70.95 while the control class. Results of t-test showed significant value 0:03 <0:05 so that we can conclude the learning model Group Investigation (GI) effect on the cognitive learning Environmental Science Biology Education Program.

Keywords: Model Cooperative Learning type Group Investigation (GI), Learning Outcomes,

1. PRELIMINARY

The government organized a national education system as stated in Law No. 20 Year 2003 on National Education System. It was intended to carry out national education based on Pancasila and the Constitution of 1945, which serves to develop skills and character development as well as the civilization of dignity in the context of the intellectual life of the nation, aims to develop students' potentials to become a man of faith and fear of God Almighty, noble, healthy, knowledgeable, capable, creative, independent, and become citizens of a democratic and responsible.

In line with the above statement, the institution needs to improve the quality of education and the need to take a look at the extent to which the learning has been done. It is necessary to improve the way of learning that still has not been as expected. Therefore, in designing the preparation of teaching need to develop learning strategies. An educator needs to choose the form of students' learning experiences meaningful methods, media, classroom situation, and everything that supports the success of the learning process should be established. The role of education in improving the quality of human resources in creating intelligent life, peaceful, democratic and open. Output of education has not been able to walk by the demands of society. This situation is a challenge for educators to prepare learners in entering the future. Improving the quality of human resources can be realized in implementing education. Efforts to improve the quality of education is one of the focuses in the development of education today.

One way to improve the quality of human resources is the human form itself with the means to learn. According Aunurrahman, (2010), learning is a process by individuals to obtain a new behavior changes as a whole, as a result of the individual's own experience in the interaction with the environment).

According Djamarah & Zain (2006), learning is the process of behavior change due to experience and practice, that means the purpose of activities are changes in behavior, both concerning the knowledge, skills and attitudes, even covering all aspects of the organism or person. Teaching and learning activities such as organizing learning experiences, teaching and learning process, assessing the learning process and results, all of which falls under the responsibility of teachers. Thus, the nature of learning is change. Learning as a process attempts to obtain someone something new behavior changes as a whole, as a result of his own experience in the interaction with the environment. Learning is a change in attitudes and behavior better, but possibly leading to a worse behavior (Slameto, 2003).

The main goal is to learn what you have learned useful in the future that is helpful to be able to learn continuously in an easier way, in order to achieve life-long learning process (long life education). To realize this, the much needed cooperation between the various parties, especially among learners or students with faculty educator. Very important role educators, lecturers are required to implement a variety of effective methods and engaging in the learning process. Based on the results of the student questionnaire, learning in the classroom requires a variety of learning models that can promote students' ability to have the ability to think and can increase the activity of learning, which is still considered not maximized. Learning strategies appropriate and effective are expected to develop innovative learning and fun so as to increase the motivation to learn and the cognitive learning. This can be realized by applying such a model of learning that can enhance active learning, student-centered, and improve the learning interaction.

According to Hamzah (2007), a teacher's ability to provide the subject matter greatly affect the learning outcomes that can be shown by the learners. Therefore, a teacher is required to have the intellectual ability, extensive knowledge, mastery of the material, have skills in a variety of teaching methods, and should be offset by the presence of a teaching method and a pleasant attitude that can create interest, motivation, and enthusiasm of students in learning.

Educators who master the material to be taught and be able to manage appropriate learning strategies, choose the medium of instruction and evaluate the results of the study are professional educators. Given the diversity of teaching models that have been applied in these schools, it would be wise if the teacher or lecturer to choose and try to use models varied teaching profession to improve quality and productivity in reference to meeting the needs of students, especially in order to improve learning outcomes. Improve learning activities can apply cooperative learning.

According to Ibrahim et al (2000) cooperative learning embodied in the work of small groups of mutual aid in learning. The small group is a heterogeneous group of four or five students, the students are a mix according to the level of achievement, gender or ethnicity. Cooperative learning is one of the best learning strategies that have been studied. The results show that students have the opportunity to work together, learn faster and more efficient, have greater memory and got a more positive learning experience.

Cooperative learning students learn and shape their own experience and knowledge together in a group. Some important elements in Cooperative Learning includes cooperation in completing the task, pushing for structured cooperation, individual responsibility and heterogeneous group. Cooperative Learning is used in a classroom that is always covered cooperation in completing the task. Two different structures are commonly used task specialization of tasks and study groups. In the specialization of tasks, some members of the group to respond to the unique part in any activity. In the study group, all group members work together and do not have a separate response. Cooperative learning is a general term for strategies that can help develop students into groups to work together and interact with each other. Cooperative learning is a good foundation for improving student achievement encouragement. By having a positive encouragement or motivation of the students will show interest. The technique of Cooperative Learning by Rusmini there are four kinds, namely (1) Student Team Achievement Division (STAD), (2) Jigsaw, (3) Team Games Tournament (TGT), and (4) Group Investigation (Chotimah et al, 2009).

Cooperative learning is different from other learning strategies. The difference can be seen from the learning process is more emphasis on the process of working together in groups. The aim is not only academic ability in the sense of mastery learning materials, but also the element of cooperation for the control of these materials. The cooperation that is the hallmark of cooperative learning (Sanjaya, 2006).

Learning environmental science in Biology Education Studies Program has been implemented with the experimental method. This learning activity is still not improving student learning optimal interaction. Based on the results of the questionnaire, students have been able to carry out the learning pretty well, it's just still requires regularity, procedural and develop the variations in learning activities. This gives consideration for faculty to choose learning strategies are quite able to encourage students to learn more actively and meaningfully. Thus the learning model used provide meaningful experiences for students so as to improve learning outcomes.

Group Investigation is a form of cooperative learning model includes three main concepts, namely: research or the inquiry, knowledge or knowledge, and the dynamics of the group or the dynamic of the learning group. Group investigation is a small group to guide and encourage the involvement of students in learning. This method requires students to have a good ability to communicate well in the group process skills (group process skills).

The final results of the group is the contribution of ideas and learning from each member of the group that in fact further hone students' intellectual abilities than learning individually.

Is a good learning strategy when creating learning environment conducive to the achievement of educational goals. In addition, learning strategies must also take into account all the conditions of the students, both internal and external circumstances of students. Investigation learning methods Group or Group investigation take the model of society, especially the social mechanisms that exist in the community is usually done by mutual agreement. Through this agreement the students learn the knowledge and they get involved in solving social problems (Winataputra, 2001).

According Trianto (2007) Group Investigation generally divide several groups consisting of 5 to 6 students with heterogeneous characteristics. The division of the group can also be based on the pleasure of friends or common interests towards a particular topic. Furthermore, students choose a topic for investigation, conducted in-depth investigation on a topic that has been selected, and then prepare and present a report to the class.

This study directs the dynamics of the students to respond to problems and solving them. Knowledge is a learning experience the students gained either directly or indirectly, while the dynamics of the group shows an atmosphere depicting a group of interacting involving a variety of ideas and opinions as well as exchange experiences with each other through the process of argumentation.

This the model of learning Group Investigation encourage students to learn more actively and more meaningful. It means that students are required always to think about a problem and they look for own solutions. They will be trained to always use the skills of knowledge, so that the knowledge and experience of their learning will be embedded for a long enough period of time so that students can improve learning outcomes.

2. LITERATURE REVIEW AND HYPOTHESES

In concluding this background, we focus briefly on issues of teaching. Research on effective teaching highlight that there is no one ideal model of teaching, but studies that seek student view identify a number of common factor predominately relating to student centeredness, expert discipline knowledge (Wither et al. 2003), intelectual excitement and interpersonal rappot (Lowman, 1994), and commitment to facilitating learning in individual student (Moses, 1985). Other reseach drawing open theoretical prespective highlight factor such as reflectivity, pedagogical content knowledge and capability to encourage deep rather than surface learning and meaningful assessment pactices (Ransden, Margetson, Martin,& Clarke, 1995). Fron a cognitive perspective Stenberg (1990) highlights the role new information is integrated as prposition and selective comparison through which the learner focuses on the relationship between new knowledge and prior knowledge (Dianne J Watters, 2007)

Group investigation, student take an active part in planning what they will study and how. They form cooperative groups according to common interest in a topic. All group members help plan how to research their topic. Then they divide the work among themselves and each group members carries our his or her part of the investigation. Finally the group synthesizes and summarizes its the class (Joyce and Weil 1972, Sharan and Hertz-Lazarowatz 1980, Miel 1952, Sharan and Sharan 1976).

Group Investigation is a effective organizational medium for encouraging and guiding student involvement in learning. Student activity share in influencing the nature of events in their group investigation, student take an active part in planning what they will study and how. They form cooperative groups accurding to common interest in a topic. All group members help plan how to research their classroom. Also by communicating freely and cooperating in planning and carrying out their chosen topic of investigation, they can achieve more than they would as individuals. The final result of the group's work reflects each member's contribution, but it is intellectually by the same student. In planning and Carrying out Group Investigation, students progress through six consecutive stage. These stages can be compressed into a week or two, or they can be carried out several weeks or even months, depending on the scope of the topic under investigation and the skilfulness of the student and the teacher

3. RESEARCH METHODS

This research was conducted in the second semester, students of Biology Education, with courses in Environmental Science Academic Year 2014/2015, Department of Biology, Faculty of Education Teacher Training and Education Mulawarman University Samarinda. This research type Quasi Experiment using two class A (treatment using Group Investigation learning model with experimental method) and B (control). The study population was all students of the second semester and the study sample class A and B. The independent variable of this study is a model of learning Group Investigation) and the dependent variable is the motivation and learning outcomes.

Data collection techniques of cognitive learning outcomes using tests, essay tests are given to follow the lattice problem, compiled oriented on the syllabus and lecture plan. The trial will test the cognitive learning done prior notice before the test is actually carried out.

Research instrument in this study is divided into two, namely: instrument implementation of research and data collection instrument. Instruments implementation of the research include syllabi, lecture plans, student worksheets and cognitive assessment instrument. Instrument data retrieval include motivation questionnaire and tests that were previously a matter to be tested in advance to determine the validity, reliability and to test the cognitive learning.

4. RESULTS AND DISCUSSION

Implementation of this research was to determine the learning outcomes and learning motivation of students in the subject of Environmental Studies with two classes namely class A (using a model of learning Group Investigation by experimental method) and class B (the direct study with experimental method). Here are the results sailed environmental science students of biology education:

Table 1. Description of Learning Outcomes

Analysis	N	Pretest	Posttest	Mean	F	t	Sig
Kelas A	23	54.69	78.09	23.39	2,229	2.59	0.13
Kelas B	23	55.73	70.95	15.21		41.02	0.13

Based on the description of the learning outcomes posttest mean value of class A (78.09) and class B (70.95). Hypothesis testing decision that the null hypothesis is rejected on the results of cognitive learning, which significantly 0:03 <0.05 then there are differences in learning outcomes learning model Group Investigation (GI) with direct instruction.

Differences in the value of learning outcomes can be understood that the learning model Group Investigation tends to follow the flow of syntax systematically so that learning more planned. Maximizing working group that has been formed may occur in the presence of a small working group to conduct the investigation, troubleshooting and problem resolution. To help carry out the work learning resource was prepared in advance. It is very helpful in improving the ability of beginning students, the analysis ability more targeted material. On learning Group Investigation learners themselves are encouraged to formulate what is obtained through written and verbal dish so that the active role of students is emphasized for the sake of the ongoing learning process. Students are directed to find, locate and solve their own problems scientifically, so in the learning process of students tend to be trained to develop thinking skills and scientific attitude.

Lecturer role as a resource and facilitator who directs the students in the face of difficulties in carrying out the experiment. Students work in groups, discuss each other, exchange opinions and carry out experiments would provide a learning experience to investigate and resolve the issues presented and directed at the formation of the concept of a material. Learning as students are expected to get a meaningful learning experience. According to Slavin (1995) in Siti Maesaroh (2005), suggests it is important to perform the method of Group Investigation is in need of the ability of the group in doing each task, each member should have the opportunity to contribute. During the investigation, students can seek information from various information from inside and outside the classroom and then students gather information supplied by each member to work on the worksheet.

Learning success is also supported by the effectiveness of the model is implemented, which is carrying out the syntax correctly. Cooperative learning model Group Investigation (GI), a student is more geared for interacting between student groups and faculty, so that students who do not understand and passive will be guided solely by friends group.

Environmental science learning material in this study is the measurement of physical environmental factors that include measurement of temperature, humidity, soil and water pH, salinity, BOD, COD and biota. Location observations include environment of river Karang Mumus Samarinda. Activities of environmental observations and measurements of physical factors begin by identifying topics and organize a group. The topic has been adapted to the syllabus, time and place has been adapted to the learning activity. Before the fieldwork, students have been guided to analyze materials and learning resources in the classroom. Following an investigation into the field to make observations and measurements. The results of investigations into the river Karang Mumus Samarinda and environment and related factors causing river water pollution as a result of the activities of human activity, both domestic and industry. Students collect information, analyze data, and make conclusions from observations and discussions. These observations strongly support the development of student thinking patterns when the interaction in the classroom. This is in accordance with Saputra et al (2012) observed that both will affect the ability to conduct inquiries. Observation and submission good questions lead to the ability assembles a hypothesis and experimental designs to be good. Through hypothesis and experimentation that will either obtained the data, data analysis and conclusions were good and eventually students can communicate in writing.

Each member of the group plays an active role to jointly conduct investigations, and complete the task group as to exchange opinions, discuss, clarify and synthesis all ideas. The final report is based on observations, measurements and results of discussion. This activity is carried out in a systematic and focused so that meaningful learning experiences. The next activity is to present the report and direct interaction between students. According Budimansyah (2007) that the model Group Investigation (GI) is often referred to as a model of cooperative learning the most complex. This is because combining several premises, which is based on the constructivist view, democratic teaching, and cooperative learning groups. Based on the constructivist view of learning with the model group investigation provide greater opportunities for students to engage directly and actively in the learning process from planning to how to learn a subject through the investigation. Democratic teaching is a learning process that is based on democratic values, namely respect for the ability, uphold justice, implementing equality of opportunity, and pay attention to the diversity of learners.

Investigation group learning model used for learning more motivating students, it can be seen from the enthusiasm of students in the following study, it has a high sense of cooperation within the group and is responsible for complete experimental activities and reports. Students are always trying actively to solve and resolve the problem, so it can be concluded that students who have high motivation tend to have better learning outcomes. This can be understood as someone who has a high motivation will have a sense of responsibility in their learning activities that include sincerity in solving the problem, complete the task on time and encourage students to learn better.

5. CONCLUSION

Based on the description and discussion of the results of the study it can be concluded:

1. Learning Group Investigation Model affect the learning outcomes of a course in environmental science biology education courses.

2. The results of classroom learning A learning model Group Investigation (GI) higher at an average value of 78.09, while class B direct learning model with an average value of 70.95.

REVERENCE

Anita Lie. 2007. *Cooperative Learning.* Jakarta: PT Gramedia. Cet. 5th

Aunur rahman.2010. *Belajar dan Pembelajaran*. Bandung:Alfabet.

Arends, R. 2007. *Learning to Teach*. 2007. The Mc Graw Hill Companies

Budiningsih, A.C. 2005. Belajar dan Pembelajaran. Jakarta: Rineka Cipta.

Chotimah dkk (2009). Strategi Pembelajaran untuk Penelitian Tindakan kelas. Surya Pena Gemilang. Malang.

Dalyono, M. 2009. Psikologi Pendidikan. Rineka Cipta : Jakarta.

Deanne J Watters and James J. Watters Approaches to learning by students in the Biological Sciences: Implications for Teaching 2007. International Journal of Science Education vol. 29, No 1, 15 January 2007, pp. 19-43

Dick, W. and Cary Lou. 1990. *The Systematic Design of Instruction.* 3rd Ed. New York: Harper Collins Publisher

Djamarah, Syaiful Bahri dan Aswan Zain. 2006. Strategi Belajar Mengajar. Rineka Cipta: Jakarta.

Hamzah. 2007. Profesi Kependidikan. Bumi Aksara : Gorontalo.

Ibrahim Muslimin, dkk. 2000. Pembelajaran Kooperatif. Surabaya : University Press UNESA.

Mudjiono dan Dimyati. 2002. Belajar dan Pembelajaran. Jakarta: Rineka Cipta.

Rusman. 2010. Model-Model Pembelajaran. PT. RajaGrafindo Persada : Bandung.

Sanjaya. 2006. Strategi Pembelajaran. Prenada Media: Jakarta

Saputra Alanindra dkk (2012), Peningkatan Ketetrampilan Proses Sains dan Hasil Belajar SiswaMelalui Penerapan Strategi Guided Inquiry di SMP Negeri 5 Surakarta. Jurnal Pembelajaran Biologi Volume 1 Nomor 1 Agustus 2012. FKIP PMIPA, Universitas Negeri Surakarta.

Slameto. 2003. Belajar dan Faktor – Faktor yang Mempengaruhinya. Rineka Cipta: Jakarta.

Slavin, E, Robert. 2009. Cooperative Learning Teori, Riset Dan Praktik. Cetakan Kelima. Bandung: Nusa Media

Trianto. 2009. Mendesain Model Pembelajaran Inovatif-Progresif. Kencana: Surabaya.

Winataputra, Udin, S. 2001. *Model-model Pembelajaran Inovatif*. Jakarta Pusat: Direktorat Jenderal Pendidikan Tinggi Departemen Pendidikan Nasional.

Problem Analysis Of Inquiry Learning Model devices That What Happens In Chemistry Teacher At SMAN Samarinda

Maradona[1], Makrina Tindangen[2], Erwin[3]
Postgraduate of FKIP Kimia Universitas Mulawarman Samarinda Kaltim.
Donamara77@yahoo.com

ABSTRACT

This study aims to determine the problem of Inquiry Learning Devices Model Happens in High School Chemistry Teacher in Samarinda. Subjects in this research were 1 teacher and 1 respondents.

Methods of analysis was done qualitatively obtained through observation, interviews, documentation and triangulation and data obtained in the research then described.
The results showed that the chemistry teacher is having problems in the preparation of RPP learning device.

Keywords: Inquiry Model, Learning Implementation Plan.

A. Introduction

Education plays an important role decisive for development and self-realization of individuals, especially for the development of the nation and the State (Munandar, 1999). The problem that often arises in chemistry learning process based on experience in managing learning between students' learning activity is very low, identified from less interest of student to ask, not too courage to express their opinions, not too courage to giving ideas, unwilling to put forth hypotheses (Soma, 2012). Inquiry model is expected to minimize. From the above explanation, the writer motivated to do research qualitative with the title "Problem Analysis of Inquiry Learning Model Devices thatHappens In Chemistry Teacher at SMAN Samarinda"

B. Method

Qualitative naturalistic research has real settings as a direct source from data and researchers is a key instrument. Qualitative research describing data derived from the words or pictures instead of numbers (Bogdan and Biklen, 1998). Qualitative research is research that aims to understand the phenomenon of what is experienced by the subject of the research such as behavior, perception, motivation, action etc., holistically and by way of description in the form of words and language, in a specific context that is naturally and by utilizing various scientific methods (Moleong, 2006). **Interview techniques, observation techniques and documentation techniques** (Sugiyono, 2011).

1. The place of research SMA N 3 Samarinda

2. Time Research
   January to August 2015

3. Subject Research
   Teachers of SMANegeri 3

C. Result

Problems faced by teachers in preparing RPP based guided inquiry that is difficult to plan the learning that is able to know the condition of the ability of students' academically, remembered that the conditions of students in a class of heterogeneous than that there is a class of excellent and regular and lacking of chemicals in conducting inquiry model so that the procedures of inquiry could not in accordance with the conditions of the laboratory. Less time from KTSP 5 hours, K13 only 4 hours, while the material is not reduced. The number of students who reach 40. The division of the steps Inquiry because it has to train, guide and familiarize the scientific method.

Should think operational behaviorism,cognitive and degree. Difficulty to accommodate students' abilities. As revealed from the interview "Normally, you should think KI KD with time allocation, should operation sinvolving 4 basic groups such as behaviorism, cognitive and degree"

D. Discussion

Based on analysis of data obtained from the triangulation of data, observation, interviews and documentation, the problems faced by teachers in preparing RPP are vary, the teachers has difficulty in reviewing the syllabus before preparing RPP. Reviewing syllabus is steps to translate the syllabus that written according to a standard process that is still common. Reviewing the syllabus is to make the details of observing activities, ask, gather information, process and communicate to the steps – steps of teacher in learning to makes students active in learning.

Besides, barriers that experienced by teachers in preparing RPP that suit the character of the students, because in one class there are various characteristics of different learners - different. This is a barrier for teachers in developing RPP in accordance with the characteristics of learners so that a implementation learning plan is good and right.

In preparing the Learning Implementation Plan (RPP) based ¬indicatorsinquiry guided - indicators in accordance with Permendikbud No. 105 of 2014 in which there are few barriers experienced by teachers in preparing RPP, follows the obstacles that occur in every component of the RPP.

a. Identity of schools, subjects and grade / semesters

By triangulation, interviews, and documentation Chemistry teacher in class XI of SMA Negeri in all ofSamarinda, has made the identity of the subjects on the RPP. The identity of which has been made including the education unit, subject, class, semester and time allocation. Wherewith identity created by Chemistry teacher in class XI of SMA NegeriSamarindaare complete. This is in accordance with Permendibud No. 105 in 2014, about the identity of subjects consisting of educational unit, subject, class, semester, and time allocation.

b. Assigning Core Competence and Basic Competence

By triangulation, interviews, and documentation Chemistry teacher in class XI of SMA NegeriSamarinda, has set KI and KD are made. KI listed in the syllabus and RPP and KD Preferred is 5.5 Describe acids and bases as well as their application in everyday life. The use of KI and KD shows that Chemistry teacher in class XI of SMA NegeriSamarinda have used the curriculum in 2013.

c. Determining indicators of achievement of competencies

By triangulation, interviews, and documentation Chemistry teacher in class XI SMA NegeriSamarinda, have established indicators of achievement of competencies made. The indicator includes cognitive, affective build character, and psychomotor. Teachers make indicator by KD, and make the indicator independently by means to analysis and review KD that chosen. Seeing this, it means teachers are already making that includes competencies that exist in KD. Supardi (3015: 180) explains that the indicator is a marker of achievement of competencies which is characterized by behavioral changes that can be measured from the aspect of attitudes, knowledge, and skills.

d. Assigning Learning Materials

By triangulation, interviews, and documentation Chemistry teacher in class XI SMA NegeriSamarinda, have established learning material that will be studied. Seeing the learning materials that exist in some RPP in setting teacher teaching material has been sort of the material up to the level of cognitive attitude or application, from simple material to material that is more difficult.

Analysis result from the selected materialchosen by teacher, it can be said that the material has been adapted to the learning objectives, the material has been sorted from narrow to a more complex matter. Only teachers have not adjust with time. In line with this, Mulyasa (3006: 304) states that in identifying the material should take into account the learners, the depth and breadth of material, in accordance with the objectives to be achieved and the allocation of time required.

e. Creating learning activities

By triangulation, interviews, and documentation Chemistry teacher in class XI of SMA NegeriSamarinda has made learning activities that will be carried out. The learning activities are made include preliminary activities, core and closing. Containing the preliminary activities: prayeractivities (religious), motivation, conveying competence to be achieved and apercepsi. In preparing the preliminary activities have difficulties when preparing activities to gain knowledge of learners, giving problems and formulate problems.

Core activities tailored to the guided inquiry learning model that is on the steps of learning the syntax of inquiry develop learners. The stages starting from the identification and clarification of issues, create a hypothesis, collect data, analyze the data and draw conclusions. In the preparation of the core activities of nearly all the teachers are confused in adjusting the phase of learning the steps - the steps contained in the model of guided inquiry.

Closing activities contains teachers together withlearners activities, namely: (a) summary / conclusion lesson; (b) reflect on the activities that have been implemented; and (c) provide feedback on the process and learning result. In preparing the closing activities have difficulties when guiding learners to make conclusions from the experiment

E. Conclusion

The problem faced by teachers in preparing Implementation Learning Plan (RPP) Chemistry with the inquiry approach that is the difficulty determining the steps of inquiry, the less time of study hour.

F. Acknowledment

1. Postgraduate ofChemistry Education Study Program of FKIP Unmul
2. SMANegeri 3 Samarinda
3. Education Departementof Samarinda City
4. Ikhsan M,

Reference

Bogdan, R. C., danBiklen, S.K..1998. *Qualitative Research in Education*. Amerika: A Viacom Street

Moelong, L. J..2006. *MetodologiPenelitianKualitatif*. Bandung: Rosda

Munandar,U.. 1999. *PengembanganKreativitasAnakBerbakat*. Jakarta: RinekaCipta

Soma, Wayan. 2012. https://jurnalwidyatech.files.wordpress.com/2012/10/artikel-april9-2012.pdf. Volume 11 No. 3 diaksestanggal 30 Maret 2015

Sugiyono, 2011. *Metode Penelitian Pendidikan*.Bandung : Alfabeta

THE INFLUENCE OF HYDROCHLORIC ACID (HCl) ACTIVATOR CONCENTRATION TO ADSORPTION CAPACITY OF CHARCOAL ACTIVE OF DURIAN'S PEEL (DURIO ZIBETHINUS) TO SUBSTANCE COLOUR OF METHANIL YELLOW

Sitti Chadijah[1)], Supiati[2)]
Department of Chemistry, Faculty of Science and Technology
State Islamic University of Alauddin Makassar
E-mail: chadijah19@yahoo.com

ABSTRACT

Durian's peel is a waste which usually burned, stacked or disintegrated and can make pollution to the environment. This condition motivates the researcher to produce the value-added product from the durian's peel, such as activated carbon and as well as it can solve the environmental problems. This research aims to know the influence to use variation of concentration of activator HCl whice produces the optimum adsorption capacity from charcoal active of durian's peel to the substance color of methanil yellow. Active carbon which is used in this research comes from durian's peel which granular types with standard -100+40 mesh. Carbon is activated by physics in furnace with 400°C heat during 2 hours and is activated by chemistry with submerged of HCI 1M, 2M, 3M, 4M and 5M during 24 hours. The result of this research shows that optimum concentration in HCI 1M with adsorption capacity from charcoal active of durian's peel is as large as 0,5350 mg/g. Whereas knowing the influence of activator is used tabulation method by statistically, where we can get F_{Hitung}0,004 is smaller from F_{Tabel}10,127. It explains that H0 is accepted to reject H1. Therefore, it can conclude that there is not significant influence to use variation of concentration of activator HCl to adsorption capacity of charcoal active from durian's peel in substance methanil yellow.

Keywords: Active carbon, adsorption, durian's peel, hydrochloric acid.

INTRODUCTION

The durian plant is one of the fruits of production. The edible part of the fruit that belongs to the low IE just 20.52%. This means there are approximately 79,48% is a part that is not utilized for consumption such as the skin and seeds of the durian, which dumped it to eventually become foul. Durian skin proportionately high *carboxymethylcellulose* (containing 50-60%) and lignin content (5%) and a low starch content (5%). Leather waste durian untapped potential for the further processed into charcoal products are easy and inexpensive it is achieved by the community in order to meet their energy needs. Furthermore, the high content of cellulose that makes skin durian can be applied more broadly into the fastener metal materials and colors.

Cellulose on the skin have the durian three hydroxyl groups that are reactive and have the unit over and over that form hydrogen bonds between molecules and intra molecule. This bond has a huge effect on their reactivity of cellulose against another clusters. Cellulose polymer composed of D-glucose monomers that can be modified by the phosphate groups. In addition, waste of skin containing fibers with durian dimension length as well as the wire walls thick enough so that it will be able to bind properly when given synthetic adhesive materials adhesive materials or minerals.

Sewage treatment from durian's peel as something more useful is one form of utilization will belong to God who created on this earth there is no futile but still there are other complementary resources that may not be realized and have not utilized properly. Allah has created all things related purposes on this earth for mankind, as his word in the Qur'an surah Al-An'aam (6:95) follows:

يُخْرِجُالْحَيَّمِنَالْمَيِّتِوَمُخْرِجُالْمَيِّتِمِنَالْحَيِّ ۚ إِنَّاللَّهَفَالِقُالْحَبِّوَالنَّوَىٰ ۖ

فَأَنَّىٰتُؤْفَكُونَذَٰلِكُمُاللَّهُ ۖ

Means:

"Indeed, Allah is the cleaver of grain and date seeds. He brings the living out of the dead and brings the dead out of the living. That is Allah ; so how are you deluded?"

Testing the quality of active charcoal as the adsorbent can be applied against certain colors like substances substance methanil color yellow. Where the substance of this color is the color substances synthesis colored brownish yellow, solid and powder with a molecular weight of 375,38 g/mol, soluble in water, slightly soluble in alcohol, instructor and somewhat soluble in acetone. This dye is banned in food. The impact of the use of yellow methanil is very dangerous if inhaled, regarding skin eye and ingested. This can be caused due to irritation of the respiratory tract, disorders of the eyes, the danger of cancer of the womb and the urinary tract. Methanil yellow substance proved to be found on many different types of foods such as tofu, noodles, crackers, sweets and food hawker yellow so that the presence in the environment can threaten human survival.

Based on previous research on the influence of the concentration of hydrochloric acid activator to quality activated carbon as adsorbent of durian skin metallic Cu with contact time of 3 hours, activated carbon adsorption capacity acquired the of 99.95%. While the adsorption capacity of activated carbon of elephant grass substancesmethanil color yellow on the contact time of 45 minutes with methanil color yellow substance concentration of 50 ppm, adsorption capacity of acquired 2,3407 mg/g.

In this research, used substances Activator hydrochloric acid (HCl), which is a strong acid compounds are stable and soluble or can dissociate fully in water so it is frequently used in chemical analysis for destruction sample analysis. Based on previous studies, activation with HCl more polluter can dissolve so that more pores are formed and the process of absorption of adsorbat to be more than the maximum activation with a fewer number of H_2SO_4 pores.This is because the wall structure of activated carbon can be marred by H_2SO_4 which is destructive. In addition, the concentrated HCl dissolves many metals and producing a metal chloride and hydrogen gas. It also reacts with basic compounds such calcium carbonates and copper (II) oxide, producing dissolved chloride that can be analyzed. In the activation process, HCl is added it will soak into the charcoal and open surfaces that initially covered, so that an active surface area gets larger.

In addition, the use of HCl can reduce pollutant formation due to the disappearance of substances pollutant in the form of oxide-metal oxides in the charcoal cover porous due to the nature of this acid can affect even ruin the network structure in plants so that it was able to enlarge the pore at the time of the occurrence of adsorption between adsorbat and adsorbents, so the active site will experience increased due to the dissolving reaction so that the impact on the enhancement of the capabilities of the adsorption.

Charcoal is a black residue in the form of porous solids results burning materials containing 85-95% carbon, produced by removing the moisture content and volatile components of materials containing carbon through the heating at high temperatures. Charcoal is a black residue combustion results in the absence of oxygen containing carbon in the form of dense and porous materials, such as wood or other biomaterial. Some poresremains closed–with hydrocarbons and other organic compounds. Its components are made up of carbon bonded (fixed carbon), ash, water, nitrogen and sulfur. All active charcoal has a porous structure, usually with a number of hydrogen and oxygen chemically bound. Active charcoal usually contains about 2% mineral that is usually indicated by the grey levels or combustion residues. Active charcoal is a common form of a wide range of products that contain carbon that has been activated to increase the broad surface. Micro Crystal-shaped active charcoal carbon graphite that pores has experienced the development of ability to adsorption gases and steam from a mixture of gases and substances that are not soluble or dispersed in a liquid.

Carbonization process is one of the important stages in the manufacture of activated carbon. Generally the process is done at a temperature of 500-800^{o}C. Carbonization process is divided into 4 stages, namely: 1) at a temperature of 100-120°C occurring evaporation of water and up to 280°C temperature starts to happen the evaporation of cellulose. Distillation is generated contain organic acids and a little methanol. 2) At a temperature of 270-310°C the exothermic reaction takes place, there is the decomposition of cellulose intensively into the solution pirolignat, gas and wood. 3) at a temperature of 310–510°C occurs the decomposition of lignin while solution of pirolignat decreased, and CO_2 gas production is declining, while the gas CO, CH_4, H_2 and increase. 4) at a temperature of 500-1000°C is the phase of refining the charcoal or increased levels of carbon.

Research Purposes

To find out whether there is influence of activator concentration of HCl on the adsorption capacity of activated charcoal durian skin on methanil yellow dye. And to find out how the optimum concentration of activator HCl that produces a maximum adsorption capacity of activated charcoal durian skin on methanil yellow dye.

METHODOLOGY

Materialsused include durian's peel (*Duriozibethinus*), pigment *methanil yellow*, aquades, HClp.a, NaOHp.a, filter paperWhatman No.41, universalpH paper, filter paper, aluminium foil, kasa hydrophilic, and cotton.

Equipmentused include UV-Vis spectrophotometer, kiln drum, sifting (40 mesh), shaker waterbath, analytical balance, an electric furnace, oven, glass tools, funnels, bottle spray, spatula, pipette volume, desiccator, a petri dish, cup porcelain, pipette scale and bulp.

Research Variables

This research consists of two variables namely variables are free and variables are bound. As for that being a free variable is the concentration of the Activator. While the bound variable is active charcoal adsorption capacity of durian's peel for color methanil yellow substances.

Research Procedure

The General Stages of Making Activated Carbon from Durian's Peel

Durian skin cleaned and washed with water several times until clean. Dehydrated skin i.e. durian is dried under direct sunlight to dry. Carbonization is done by inserting the skin dried durian into kiln drum and then burned on the stove (1 durian skin drums weighing 1.9 kg, generating 480 grams of carbon). Results obtained from carbon combustion then crushed until smooth to ease the process of sifting. The process of sifting carbon (charcoal) with durian skin using a sieve (Grandsize) size + 40-100 mesh (grain taken was a grain passes in 40 mesh). Activation of activated carbon are physically and chemically, namely by means of charcoal have been sifted next activated in the furnace at temperatures of 400^{o}C for 2 hours. It is cooled and then soaked in HCl concentration variation with 1 M, 2 M, 3 M and 5 M for 24 hours. Filtered and washed with aquades so that neutral filtrate then dried in an oven at a temperature of 105oC for two hours and then put in a desiccator.

Making of Solution of Dye Methanil Yellow

The making of the parent substance of solution of dye methanil yellow 1000 ppm weighed 1 gram of a substance's dye methanil yellow, then reconstituted with aquades until the right volume of 1000 mL.Making a solution of dye methanil yellow with 100 ppm. As many as 50 mL of a solution of methanil yellow 1000 ppm incorporated into a 500 mL measuring flask and diluted with aquades until the sign limits. The manufacture of standard curve of solution of 100 ppm, created the series of dye methanil yellow substance concentration, with using the eyedropper tool 5 mL to 5.0 ppm; 10 mL to 10.0 ppm; 15 mL to ppm 15.0; 20 mL to 20.0 ppm and 25 ppm to 25,0 mL, respectively into the pumpkin and then measure out 100 mL of squeezed up with the aquabidest to mark the boundaries, which are then measured its absorbance using UV-VIS spectrophotometer at a wavelength of 430 nm.

Determination of Optimum Concentration of Dye Methanil Yellow

0.5 grams of activated carbon put into 100 ml of a solution ofdye methanil yellow of the substance concentration variation with 0.05 ppm, 1.0 ppm, 2.5 ppm 5.0 ppm, 10.0ppm, 20.0 ppm, 30,0 ppm, 40,0ppm and 50.0 ppm reaction flask then beaten with a solution of shaker waterbath with the speed of 120 rpm for 45 minutes. Furthermore each mixture is filtered using the filter paper Whatman No.41. The filtrate produced its absorbance is measured by using a UV-VIS spectrophotometer at a wavelength of 430 nm.

Determination of the Optimum concentration of the activator HCl by variations of 1 M; 2 M; 3 M; 4 M; and the Optimum concentration of 5 M with dye Methanil yellow 10 ppm

Each 0.5 grams of activated carbon concentrations 1 M; 2 M; 3 M; 4 M; and 5 M put into 100 mL of a solution of dyemethanil yellow with a concentration of 10 ppm. Solution of whipped with shaker waterbath with the speed of 120 rpm for 45 minutes. Furthermore each mixture is filtered using the filter paper Whatman No. 41. The filtrate produced its absorbance is measured by using a UV-VIS spectrophotometer at a wavelength of 430 nm (duplo in Treatment).

Determination of Adsorption isotherms

An Erlenmeyer flask containing an optimum adsorbent weight dissolved in 100 mL of a solution of dye methanil yellow with optimum concentration on adsorbent is then filtered using the filter paper Whatman No. 41. The filtrate produced its absorbance is measured by using a UV-VIS spectrophotometer at a wavelength of 430 nm. Then the measured adsorption capacity which corresponds to Langmuir and Freundlich isotherm model.

Data Graphs

From the results of the analysis made the charts between adsorbent with methanil color yellow substance concentration (ppm) so that the calibration curve obtained with the equation of a straight line:

$$y = ax + b$$

Means:
y = absorbance of dye methanil yellow
x = methanil yellow dye concentration (ppm)
a = slope
b = intercept

From the above equation then the concentration of the substance is methanil yellow colour (ppm) can be calculated. The number of methanol yellow that adsorption mg/g of adsorbent (durian's peel) is determined by the equation above.

$$W = \left(\frac{C \quad - C}{W}\right) V$$

Means:
W = Effectiveness number of methanilyellow dyes adsorbed (mg/g)

Co = initial concentration of methanil yellowdye(mg/g)
Ce = equilibrium concentration (residual) of dye methanil yellow (mg/g)
Wa = weight of adsorbent/activated carbon from durian peel (g)
V = volume of the solution (L)

For efficient use of active charcoal absorption from the durian peel for dye methanil yellow, can be calculated with the equation:

$$Q = \left(\frac{C \quad - C}{C}\right) X\ 100\%$$

Means:
Q = efficiency of absorption/weight of adsorbent (mg/g of adsorbent)
V = volume of the solution (L)

For the determination of the adsorption capacity of activated carbon from the durian peel for dye methanil yellow determined from equation of Langmuir and Freundlich isotherm. For the data that satisfies the equation of Freundlich adsorption capacity, calculated with the equation:

$$y = a.x + b$$

Log w = a log Ce + b
Log w = 1/n log Ce + log k
Log x/m = 1/n log Ce + log k
Where:
y = Log w
a = 1/n
x = Log Ce
b = Log k
Log k = intercept
k = inv log intercept

RESULTS AND DISCUSSION

The standard curve is a picture that shows the relationship between a certain rays absorption with the concentration of a substance to absorb light. To determine the optimum concentration of substance of dye methanilyellow, used standard solutions 5 ppm, 10 ppm 15 ppm, 20 ppm and 25 ppm. Standard curve equation methanil yellow the resulting is y = 0, 046x + 0,014 with R2 = 0,998. The results of this research can be seen as follows:

Table 4.1 . Data from the absorbance measurement of a standard solution of methanol yellow In Wavelength 430 nm

Standard code	methanil yellow concentration (ppm)	Absorbance
Blanco	0,0	0,04003
Standard 1	5,0	0,2247
Standard 2	10,0	0,4527

Standard 3	15,0	0,7137
Standard 4	20,0	0,9461
Standard 5	25,0	1,1731

The relationship between variations in the concentration of the standard solution and the absorbance of dye methanil yellow in Figure 4.1 .

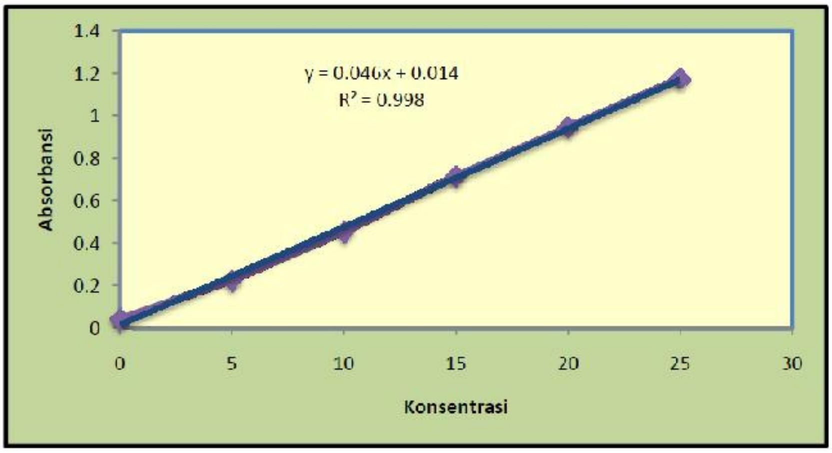


Figure 4.1 . Charts between the concentration and power of adsorptionstandard solution frommethanil yellow dye.

Table 4.2 .Measurement Result Data of Variation of Concentration Dyes Methanil Yellow At Maximum Wavelength 430 nm.

No.	**Initial concentration MY (Co) mg/L**	**Residual concentration MY (Ce) mg/L**	**Absorbed concentration (Co-Ce) mg/L**	**Effectiveness MY absorbed mg/g**
1.	0,01	0,00804	0,00196	0,0016
2.	0,05	0,0018	0,04821	0,0096
3.	1,0	0,1249	0,8751	0,1750
4.	2,5	0,6298	1,8702	0,3740
5.	5	0,2445	4,7555	0,9511
6.	10	3,0460	6,9540	1,3908
7.	20	13,0845	6,9155	1,3831
8.	30	23,1930	6,8070	1,3614
9.	40	33,2125	6,7875	1,3575
10.	50	43,3485	6,6515	1,3303

Table 4.4.The average data of substance of methanil yellow the adsorption by activated carbon skin durian on the different variations of the concentration of the activator with color methanil yellow substance concentrations used i.e. 10 ppm (λmaks. 430 nm).

No.	Co (mg/L)	Ce (mg/L)	Co-Ce (mg/L)	Adsorption capacity or W (mg/g)
1.	10	2,7478	7,2522	1,4504
2.	10	4,9087	5,0913	1,0183
3.	10	6,3956	3,6044	0,7209
4.	10	6,1870	3,8130	0,7626
5.	10	6,1043	3,8957	0,7914

The effectiveness of activated carbon adsorption fromdurian's peel against variations in activator concentration ofHCl in the equilibrium state (the rest) can be seen in Table 4.4. From the table 4.4, it appears that the methanilyellow dye remaining there change. Where in the table shows that the number of methanilyellowremaining by active carbon highest indurian's peel is 1.4504 mg/g in the concentration of HCl 1M activator, while the activated carbon adsorption capacity of the lowest durian's peel is 0.7209 mg/g on the concentration of the activator HCl 3 M. Shows the graph between x/m or W (effective adsorption) with the equilibrium concentration (residual) from dye methanil yellow mg/L or Ce.

Data of activated carbon adsorption from durian's peel against methanil yellow dye that is activated at a temperature of 400^{o}C physically and chemically using HCl activator substances in various activator concentrations of HClare 1M , 2M , 3M , 4M and 5M. The data is used to determine the adsorption capacity methanil yellow by activated carbon from durian's peel, using the method according to the chart isotherm Langmuir or Freundlich, by making a graph showing the linear curve of the relationship between the equilibrium concentration (residual), Ce (ppm) with Ce/W (g/L) for the Langmuir isotherm patterns, as well as linear curve of relationship between Ce Log in Log W to the pattern isotherm adsorption ofFreundlich.

For chemical activation process used HCl which aims to expand the volume of the cavity or pore activated carbon because activator molecules to be adsorbed by carbon material that will dissolve the impurities that are in carbon pore such as inorganic minerals. The activation process through two stages of activation that is physically and chemically. Physical activation is done by heating in a furnace at a temperature of 400^{o}C for 1 hour, while chemical activation is done by soaking the carbon in a solution of HCl with various concentrations of 1M , 2M , 3M , 4M and 5M it aims to determine the maximum capacity of acid in expanding the pores of charcoal which will affect the adsorption power of the charcoal itself. The chemical composition of the durian's peel contains carboxymethylcellulose high (50-60%) and lignin content (5%) and low starch content (5%), so either be used as activated carbon.

Effect of Activator Concentration Variation HCl

The influence of the activatorconcentration of solution hydrochloric acid (HCl) to adsorb methanil yellow dyes used variations HCl concentration is relatively high as 1 M, 2 M, 3 M, 4 M and 5 M with the aim to determine the adsorption capacity of the activated carbon from durian's peelwith activated of highest concentrated acid. It is known that the nature of HCl that can remove metal oxides in a charcoal cover the pores due to the nature of these acids can affect the network structure in the plant so as to enlarge the pores at the time of adsorption between adsorbate and adsorbent when compared with other acids for example H_2SO_4, more little amount of pores.

This is because the walls of the structure of the activated carbon can be undermined by H_2SO_4 that is destructive ends. The results obtained for the variation of the activator concentration. Based adsorbance value indicates that the active carbon absorption from durian's peel against methanil yellow dye increased with increasing concentration of HCl to be at a concentration of 3M HCl with adsorbance by 0.1404; 0.2398 and 0.3082 mg/L, then adsorbancedecreased on the concentration of HCl 4M and 5M with adsorbance value of 0.2986 mg/L and 0.2948 mg/L.

But adsorbance with high value can't be used as a benchmark and the effectiveness of activated carbon has a good adsorption capacity. From Table 4.4 shows that the average of methanil yellow dye adsorbed to the concentration of methanil yellow dye used respectively 10 ppm, produced the highest adsorption effectiveness in 1M HCl activator concentration is equal to 1.4504 mg/g with low adsorption effectiveness with activator concentration is 3M HCl of only 0.7209 mg/g, in other words, adsorbance inversely proportional to the effectiveness or the ability of activated carbon to adsorb dye methanil yellow.This means the higher the adsorb obtained indicate the levels of a substance in a solution of dye methanol yellow is still large, in other words the height adsorb obtained indicate the activated carbon ineffective durian skin in absorbing substance of dye methanilyellow. From table 4.3, the effectiveness of active carbon absorption of skin color methanil substances on durian yellow decline until the concentration of the activator 3M with the highest effectiveness of absorption in a row for the concentration of the activator 1 M, 2 M and 3 M that is 1,4504 mg/g; 1,0183 mg/0,7209 mg/g and g. next on the concentration of the HCl Activator 4 M and 5 M a little experience increased effectiveness i.e. adsorption of 0,7626 mg/g and 0,7914 mg/g.

Instability adsorption capacity of activated carbon from durian's peel at various concentrations activator HCl to dyes methanil yellow is due at the time of substance use activators are high can result in carbon molecules tend to be under acidic conditions so as to have more partial positive charge (H^+ ions), which will result in the interaction of activated carbon with methanil yellow dye which also has a partial positive charge will experience electrostatic repulsion, in other words not occur dipole-dipole interactions on the surface of activated carbon with dye methanil yellow of molecule so the adsorption is happening is relatively low.

The results of the data analysis capacity of activated carbon adsorption for durian skin pattern isothermlangmuir (b) was 0,5350 mg/g means activated carbon skin durian every gram able to absorb 0,5350 mg of dye methanil yellow substances contained in the solution. Freundlich isotherm patterns to (k) of 0,1581 mg/g to find out whether there is influence of the concentration of the activator on active carbon absorption of the skin color of the substance against the durian, known after performing data analysis in statistics, and get p (probability) IE 0,155 which is greater than the quantity α that is 0.05 meaning that H0 is accepted and rejected the H1. This indicates that there were no significant effects of the use of the variation of concentration of the HCl Activator for the adsorption capacity of activated charcoal from durian's peel on methanil yellow dye.

CONCLUSION

Conclusion

There are no significant effects with the use of a variation of the concentration of the HCl Activator against active charcoal adsorption capacity from durian's peel on methanil yellow dyes. And the optimum concentration of activator that produced a maximum adsorption capacity of activated carbon from durian's peel on metanhil yellow dye that is in HCl 1 M to adsorption capacity of 0.5350 mg/g.

Suggestion

Conduct further research using immersion time variations in the chemical activation stage. Using HCl activator concentration below 1 M. And using alkaline activator or using activated carbon weight is greater.

BIBLIOGRAPHY

Ahsan, AbduhAndiSitohang, "Utilization of waste rice husks for activated charcoal as an adsorbent," *PKM Journal, Bogor Agricultural Institute*, (2009).http://repository.IPB.ac.id.

Anggarawati, Kadek. "Capacity of Carbon Adsorption of Bagasse (*Saceharumofficinarum,)* to dyes Rhodamin B," Faculty ofMIPA UNM, Makassar, 2009.

Arif Tiro, Muhammad. *Basics of Statistics*. Makassar: Andira Publisher, 2008.

Arifin, "Potential of Activated Carbon Adsorption as Heavy Metal Lead (Pb)and Cadmium (Cd)," *A Collection of Related Reference Adsorption of Heavy Metals*,(September 2008).http//:www.*repository.usu.ac.id/bitstream/ 123456789/34583/2/ Reference.pdf*.

Atkins PW. *Physical Chemistry Vol II.*Kartohadiprodjo II, Translator; Rohhadyan T,Editor Translated from *Physical Chemistry*. Oxford: Oxford University Press,1999.

DediSuhendra, "Manufacture of Activated Carbon from Corn Stalks using Activator Sulfuric Acid (H_2SO_4) on the Absorption of Copper (Cu) ions," *Full Journal Manufacture of Activated Carbon from Corn Stalks*, (2011). http://repository .usu.ac.id/bitstream/123456789/29844/4/Chapter%20II.pdf.

Religion Department.*Al-Quran and Terjemahnya*. Jakarta: Religion Department RI,1985.

Durra Hapid, “Adsorption Capacity of Silica Sand to Dye Rhodamin B,”Faculty of Mathematics and Natural Science, State University ofMakassar, Makassar 2013.

DwitadanSrihapsari “The Use of Natural Zeolite that has been Activated with a Solution of HCl to Absorb Metals cause Water Hardness,”*Journal of Technology* , vol. 4 no. 2, (2011).

Fessenden RJ dan Fessenden JS.*Organic Chemistry*.Vol 1.Third Edition. Translator:Pudjaatmaka, Translated from: Organic Chemistry. Jakarta: Erlangga, 1986.

Herawati, “Capacity of Carbon Adsorption of Cocoa Fruit (Theobrama cacaoL.) Leather to Metal Ca and Mg in the Water Wells in BorongUnti’e Village,Pangkep,” Undergraduate Thesis, Faculty of Science and Technologi UINAlauddin, Makassar, 2010.

Hidayat, “Food Containing Natural Dyes and Synthetic,” *Journalof Technology*, (2010).http://eprints.undip.ac.id/2857/1/Jurnal_J2C004101.pdf.

EFFECTS OF CYTOKININ TYPES AND THEIR CONCENTRATIONS ON CALLUS FORMATION FROM DIFFERENT SOURCES EXPLANTS OF SARANG SEMUT PLANT (Myrmecodiatuberosa Jack.)

Yanti Puspita Sari[1*], Wawan Kustiawan[2], Sukartiningsih[2], Umrah[1]
[1]*Faculty of Mathematics and Natural Sciences* [2]*Faculty of forestry*

*request for offprint email ypsman2002@yahoo.com

ABSTRACT

This study aim was to determine the influence of types and different concentration of cytokinin on the callus formation. The different sources of explant (cotyledons, stems, tubers, roots) from sarangsemut plants was cultured in Murashige-Skoog medium, supplemented with various levels of 2.4 *Dichlorophenoxy Acetic Acid* (2.4 D)viz0.5; 1; 1.5; 2 mg/l and combined with 2mg/l kinetin were performed to investigate callus formation. The results showed that the best callus formation was found on medium-supplemented with 2 mg/l 2,4-D and 2 mg /1 Kinetin on four sources of explant used. In addition, phenolic, alkaloids, flavonoids, tannins and steroids were also present in the callus.

Keywords: Callus, 2,4-D, Kinetin , Sarangsemut plant (Myrmecodiatuberosa Jack.)

RELATIONSHIP BETWEEN STUDENT'S IMAGINATION ABILITY AND CONCEPTION ON ATOMIC STRUCTURE CONCEPTS

Helda

SMP Negeri 19 Samarinda

helda_vw11@yahoo.co.id

ABSTRACT

Atomic orbital concept is a difficult subject for many high school and beginning undergraduate students, as it includes mathematical concepts not yet covered in the school curriculum. It requires certain ability for abstraction and imagination.The ability of imagination is one of mental model attributes affecting on student's conception. This study aimed to identify imagination ability of student who had misconception and examine relationship between student's imagination ability and conception in atomic structure concepts. The object of this research was130 students of eleventh gradeof SMANSumberrejo and SMAN Model Terpadu, Bojonegoro. Student's misconception was determined based on the results of conceptual understanding (atomic structure) test. The student's imagination ability was determined through the imagination diagnostic test that has been qualified in terms of validity and reliability. It was categorized into three levels, namely, high as level 1, moderate as level 2, low as level 3. The burden of student's misconception was categorized into three levels involving low, middle, and high. Determining of it used central tendency (mean) and dispersion (standard deviation). There were three main result of this research. First, students who had misconception have varying abilities to imaginating in all levels (level 1 to level 3). Second, the average percentage of students who had misconception with low, middle, and high level of imagination abilityare 81.3, 76.7, and 47.9 % respectively. Third, based on the results of X^2 analysis, it was obtained p-value 0.019, less than $\alpha = 0.05$. It means that there was relation significantly between the level of student's imagine ability and burden misconception level. Students having low imagine ability had the high possibility for possessing misconception in atomic structure concepts.

Keywords: imagination ability, misconception, and mental model

THE CORRELATION BETWEEN LEARNING INDEPENDENCE AND STUDENTS LEARNING RESULT IN CHEMISTRY THROUGH THE IMPLEMENTATION OF DISCOVERY LEARNING MODEL ON SALT HYDROLYSIS TOPIC IN MAN 2 SAMARINDA ACADEMIC YEAR 2014/2015

Nurlaili[1)], Awalus Sarifah[2)]
[1]Faculty of Teacher Training and Education, Mulawarman University
Email: nurlailisyamsul@yahoo.co.id
[2] Faculty of Teacher Training and Education, Mulawarman University
Email: awalussyarifah@gmail.com

ABSTRACT

Learning independence is related to self-management to achieve learning goals, including learning result. One of the learning models which demands students learning independence is the discovery learning. This study aims to: (1) to measure the students level of chemistry learning independence through the implementation of discovery learning model, (2) to determine students learning result through the implementation of discovery learning model on salt hydrolisis topic, (3) to determine positive correlation between learning independence and students learning result in chemistry through the implementation of discovery learning model on salt hydrolisis topic in MAN 2 Samarinda, academic year 2014/2015.

This study is classified as associative research. The population of this study is the whole students of MAN 2 Samarinda, while the sample is class XI Science I, whose number is 31 students. The sample is determined by using purposive sampling method. The learning independence data is obtained from learning independence questionnaire, adapted from assessing academic self-regulated learning and students learning result in chemistry is obtained from post-test and regular quiz. The data then analysed by using Pearson's product moment correlation. The result showed the students learning independence in percentage as follows: highly independent (12.90%), independent (51.61%), fairly independent (35.48%), less independent (0%) and not independent (0%). The learning results percentage are as follow: very high (9.67%), high (19.35%), medium (51.56%), low (19.35%) and very low (0%). There is a positive correlation between learning independence and learning result on medium level (0.433).

Keywords : learning independence, learning result, discovery learning, Pearson's product moment correlation

INTRUDUCTION

The ideal in teaching and learning process is the existence of two-way interaction between teacher and students in an equal manner, yet in the real situation teacher is still dominant, making the students become less active. Students can become more engaged if teacher uses the appropriate learning model. One of learning models which emphasizes direct experiment on field is the discovery learning model. This model gives students chance to find learning concepts on their own, in this case, the teacher does not provide learning material in its final form.

Discovery learning model utilizes many methods, including experiment. Experiment activity engages student in investigation process, and through this involvement, students will gain correct understanding of learning concepts, become skillful and able to make conclusion. The study conducted by Hilmina (2010) showed that the implementation of discovery learning method through laboratory activity could improve students learning result in chemistry.

Discovery learning model demands self-confidence, the habit to act as subject and also independence. Independence should be grown in students from early age. The application of this model becomes a consideration to strive a success which has fairly significant implication in causing independence to emerge in themselves. The research conducted by Sunarsih (2009) showed that there is a meaningful relation between learning motivation, learning independence and academic guidance toward learning achievement. Based on all above, researchers are interested to conduct a study on “The Relation between Learning Independence and Students Learning Result in Chemistry through the Implementation of Discovery Learning Model on Salt Hydrolysis Topic in MAN 2 Samarinda, Academic Year 2014/2015.”

RESEARCH METHOD

This research was conducted in MAN 2 Samarinda on May 2015. This research is classified as associative quantitative-descriptive research. The sample was 31 students from class XI-Science 1. The sampling was done by using purposive sampling technique.The instruments used in this research are questionnaire (adapted from assessing self-regulated learning) and learning test (as the main data), interview, documentation and observation sheet as complementary data.

Data Analysis

1. Questionnaire data analysis
   a. Scoring for questionnaire data using Likert scale

Table 1. Criteria of Answer

Score	Answer
5	always
4	often
3	sometimes
2	rarely
1	never

b. Calculation of learning independence percentage

$$\text{Percentage } (\%) = \frac{\Sigma X}{\Sigma Y} \times 100\%$$

ex:
ΣX : student score
ΣY : maximum score

(Sugiyono, 2001)

c. Interpretation category of learning independence

Table 2. Category of Learning Independence

Percentage	Criteria
81% - 100%	highly independent
61% - 80%	independent
41% - 60%	fairly independent
21% - 40%	less independent
0% - 20%	not independent

2. Final score tabulation

a. Final score

$$F \quad S \quad = (30\%\, P_1 + 30\%\, P_2) + 40\% U$$

b. Interpretation criteria for learning result

Table 3. Criteria of Learning Result

Score	Criteria
80–100	very high
70–79	high
60–69	medium
40–59	low
0–40	Very low

3. Evaluating hypothesis

a. Precondition test by using linearity test and normality test with significance level at 5%.

b. Hyphotesis evalation by using Product Moment correlation.

$$r_x = \frac{n \sum X \; - \sum X \sum Y}{\sqrt{\{n \sum X^2 - (\sum X)^2\}\{n \sum Y^2 - (\sum Y)^2\}}}$$

c. Testing significancy by using t-test

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

d. Interpretation of correlation coefficient

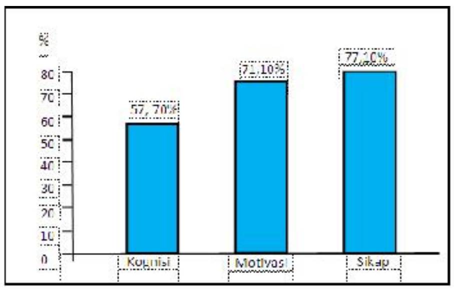
Table 4. Interpretation of Correlation Coefficient

correlation coefficient	**Interpretation**
0.00-0.199	Very low
0.20-0.399	low
0.40-0.599	medium
0.60-0.799	strong
0.80-1.000	Very strong

RESULT AND DISCUSSION

1. Students learning independence

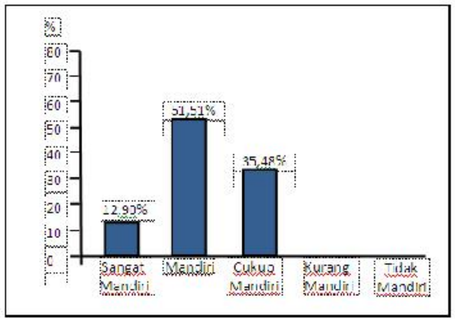
Learning independence is student's ability to do self-learning as an intensive process which is common to do to achieve learning goals. Students learning independence is measured by using learning independence questionnaire which is arranged based on the three domains of learning independence, namely cognitive, motivation and behavior. Each of them has their own measurement scale.



Based on the graph above, from those three domains of learning independece, it is known that there is imbalance between cognitive, motivation and behavior domain in the students learning independence in class XI Science 1. Overall, the percentage of behavior domain is higher compared to cognitive and motivation domain. Cognitive domain at percentage 57.70% indicates that not all of the students conduct cognitive independence activity as a whole. As the result, students do not possess the tendency to memorize and understand learning topic, doing a deep approach in learning process, organizing and planning learning topic, managing and monitoring learning strategy; therefore the level of students cognitive independence should be improved in order to support the achievement of learning result.

The percentage of motivation domain at 71.10% shows that at least half of the students has conducted activities, that individually have certain purposes such as proposing, maintaining or increasing their desire to start, provide or finish an activity or specific goal. Behavior domain, which has the highest percentage amongst the three, that is at 77.10% shows that almost all students do effort management, time and learning environment management and also the effort to seek for help.

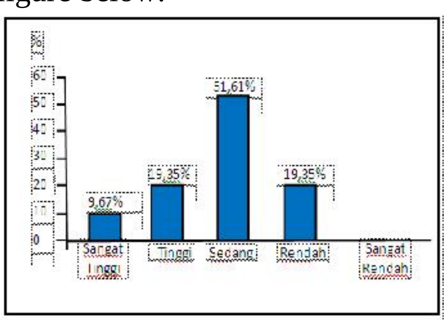
The scores of students learning independence is then interpreted into learning indepndence criteria.



Based on the figure above, it is known that the percentage level of each criteria is as follows: highly independent, 12.90% (4 students); independent, 51.61% (16 students); while less independent and not independent criteria are at 0%. This indicates that students of class XI Science I MAN 2 Samarinda, academic year 2014/2015, have learning independence criterias as follow: fairly independent, independent and highly independent; however there is also several students that fall into less independent criteria. This independence distribution happened because students have different habits to conduct learning activity. Students have their own ways to manage their independence.

2. Students learning result

The type of learning result used in this study is the cognitive learning result. The learning result is obtained after students conducted learning process by using discovery learning method on salt hydrolysis topic. The test score then interpreted into score criteria: very high, high, medium, low and very low. The percentages of students score is displayed on figure below.



Based on diagram above, as many as 3 students (9.67%) have very high learning results (80 – 100), 6 students (19.35%) have high learning results (70 – 79), 16 students (51.61%) have medium result, 6 students (19.35%) have low result (40 – 59), while no students fall into very low criteria (0 – 39). As many as 25 students have results that classified as medium to high, however there are still 6 students whose results fall into low criteria so that there is a necessity to improve the results.

The learning results gained by students are not optimal. This happened because students have different abilities, not all of them can understand the topic quite well; for instance, there is even a student that is not able to create chemical equation.

3. The relationship between learning independence and chemistry learning result

Normality test shows that learning independence and chemistry learning results data have normal distribution. Linearity test shows that there is significant regression of the data, in linear pattern. This indicates that the collected data is appropriate to be tested using parametric statistic.

Hypothesis evaluation is conducted to find postive relationship between learning independence and students learning result in chemistry through the implementation of discovery learning model, by using product moment correlation. The analysis test shows that learning independence and students learning result in chemistry has correlation coefficient at 0.433, indicating that there is medium correlation between those two. Significancy test by using t-test shows that $t_{hit}= 2.8 \quad t_{tab} = 1.69$, resulting in the acceptance of Hα (rejection of H_0), thus it can be concluded that there is positive result between learning independence and chemistry learning result through the implementation of discovery learning model on salt hydrolysis topic in MAN 2 Samarinda, academic year 2014/2015.

The learning model used by teacher needs to support learning independence in students. Discovery learning model causes students in class XI Science 1 have numbers of chances to play active part during learning process, taking intiative to conduct experiment and solving problems in students worksheet (LKS) and also have self confidence to interact with teacher and peers. Several respondents being interviewed stated that this model trains students' speaking and asking ability and also concluding ability, because they feel free in finding concept so that it invokes their confidence and learning independence.

Cognitive independence uses four measurement scales, they are practice, elaboration, organization and metacognitive management. Cognitive independence is embodied in practice by memorizing keywords, writing and re-reading the topic repeatedly to help the students to gain better understanding. This is strengthened by classic learning theory which states that repetition will give support to train thinking ability, to memorize and to observe (Ainurrahman, 2012).

Motivation domain uses seven measurement scales, including self-communication mastery, external self-communication, self-communication ability, improvement in interest, improvement in interest based on situation, self consequence and also the regulation of learning environment.

The improvement in interest is actualized by convincing one's self that salt hydrolysis topic is important to be studied because someday it will come to a need, and to relate the activity being conducted to one's interest. Interest fitted activity will make students become more enthusiast in learning process because they are attracted to learning content. This supports the statement which states that interest plays a big role in learning because if there is zero interest, the students will not perform their best, since there is no attraction (Suryono dkk, 2012).

Motivation independence is able to support students success in acieving learning goals. This is supported by statement which declares that motivation determines the level of success and failure in students learning activity; it is hard to learn without having any motivation (Oemar, 2010). On the other hand, the reality is, not every students has strong motivation in themselves, for instance, several students only conducted the experiment to the degree necessary (not performing their best), which depicts less self-communication ability (relative ability self-talk); therefore, it is necessary to improve motivation in students.

Behavior independence can be realized in three things, namely effort management, time and learning environment management and effort to seek for help. Effort management is shown by keep working hard to complete all tasks given despite he/she dislikes them. This enforces students to keep doing their school's duty. Time and learning environment management is actualized by learning in certain places where he can focus best at home and try to make a good use of time. This drives students to manage their learning schedule and to find the appropriate place to help them to concentrate in order to prepare learning topics at school. According to Tyler, to support effective learning, students need to create a condusive learning environment (Khoiru, 2011).

The findings of this study is there is a positive correlaation between learning independence and students learning result in chemistry through the implementation of discovery learning model on salt hydrolysis topic in MAN 2 Samarinda, academic year 2014/205, whose value falls into medium category. This implies that learning independence will influence students learning result, but this factor alone will not be enough, since there are other influencing factors such as internal factor, including biological and psychological aspect and also external factor such as family, school environment etc (Ainurrahman, 2012).

CONCLUSION

Based on the results, data analysis and discussion, it can be concluded that :

1. The percentage of students learning independence in class XI Science 1 MAN 2 Samarinda, academic year 2014/2015 is as follows : highly independent (12.90%), independent (51.61%), fairly independent (35.48%), less independent (0%) and not independent (0%).
2. The percentage of students chemistry learning resultin class XI Science 1 MAN 2 Samarinda, academic year 2014/2015 on salt hydrolysis topic is as follows : very high (9.67%), high (19.35%), medium (51.61%), low (19.35%) and very low (0%).
3. This study shows that there is positive correlation between learning independence and chemistry learning result through the implementation of discovery learning model on salt hydrolysis topic in MAN 2 Samarinda, academic year 2014/2015, at medium level (0.433).

BIBLIOGRAPHY

Ainurrahman. 2012. *Belajar dan Pembelajaran.* Bandung : Alfabeta

Alwi. 2007. *Kamus Besar Bahasa Indonesia*, Jakarta: Balai Pustaka

Arikunto, Suharsimi. 2006. *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta

Chang, Raymond. 2005. *Kimia Dasa Konsep-Konsep Inti Edisi Ketiga Jilid 2*. Jakarta: Erlangga

Daryanto, 2009. *Panduan Proses Pembelajaran Kreatif& Inovatif*. Jakarta : AV Publisher

Dimyati dan Mudjiono, 2006. *Belajar & Pembelajaran*. Jakarta : Rineka Cipta

Hamalik, Oemar. 2010. *Proses Belajar Mengajar*. Jakarta : PT Bumi Aksara

Hamalik, Oemar. 2010. *Psikologi Belajar & Mengajar*. Bandung: Sinar Baru Algesindo

Holstein, Hermann. 1987. *Murid Belajar Mandiri*. Bandung: Remadja Karya

Khoiru, Ahmad. 2011. *PAIKEM GEMBROT*. Jakarta : PT. Prestasi Pustakaraya

Johari dan Rachmawati. 2009. *Kimia SMA dan MA untuk Kelas XI*. Jakarta: Penerbit Erlangga.

Kasmadi dan Nia Siti Sunariah. 2014. *Panduan Modern Penelitian Kuantitatif.* Bandung : Penerbit alfabeta

Purba, Michael. 2007. *Kimia Kelas XI SMA /MA*. Jakarta : Erlangga

Misbahuddin dan Iqbal Hasan.2013. *Analisis Data Penelitian dengan Statistik*. Jakarta : Bumi Aksara

Rizema, Sitiatava. 2013. *Desain Belajar-Mengajar Kreatif Besbasis Sains*. Yogyakarta: DIVA Press

Rizema, Sitiatava. 2013. *Desain Evaluasi Belajar Berbasis Kinerja.*Yogyakarta: DIVA Press

Rusman. 2013. *Seri Manjemen Sekolah Bermutu: Model-Model Pembelajaran Mengembangkan Profesionalisme Guru, ed kedua*. Jakarta: PT Raja Grafindo Persada

Sudjana. 2005. *Penilaian Hasil Proses Belajar Mengajar*. Cetakan 10. Bandung: PT Remaja Rosdakarya Offset

Sugiyono.2013. *Metode Penelitan Pendidikan*. Bandung : Alfabeta

Suryono, dkk. 2012. Belajar dan Pembelajaran. Bandung : Remaja Rosda Karya

Syah. 2004. *Psikologi Pendidikan Suatu Pendekatan Baru*. Bandung: PT Remaja Rosdakarya.1996.

Takdir, Mohammad.I. 2012. *Pembelajaran Discovery Strategy &Mental Vocational Skill.* Yogyakarta: DIVA Press

Sumarmo,Unggul. 2004. *Kemandirian Belajar: Apa, Mengapa dan Bagaimana Dikembangkan pada Peserta Didik*. Laporan Penelitian Hibah Pascasarjana UPI. Bandung : tidak dipublikasikan.

Sunarsih, Tri. 2009. *Hubungan antara Motivasi belajar, Kemandirian Belajar, dan Bimbingan Akademik, Terhadap Prestasi Belajar Mahasiswa di STIKES A.Yani Yogyakarta*. Tesis. Surakarta: Program Pasca Sarjana Universitas Sebelas Maret

Susanti. 2014. *Analisis Kemandirian Belajar Melalui Pendekatan Pembelajaran Berorientasi Aktivitas Mahasiswa Dalam Kegiatan Praktikum Kimia Analitik Kuantitatif Pada Mahasiswa Pendidikan Kimia Angkatan* 2012. Skripsi. Samarinda : Universitas Mulawarman

Wolters, C. A., P. R. Pintrich, dan S. A. Karabenick. 2003. *Assessing Academic Self-Regulated Learning*. Makalah yang dipersiapkan untuk Konferensi pada Indicator of Positive Development: Definitions, Measures, and Prospective Validity. Disponsori oleh Child Trends, National Institutes of Heal

THE DIFFERENCE BETWEEN INQUIRY AND DIRECT LEARNING MODEL USING DRILL METHOD TOWARDS STUDENTS LEARNING ACHIEVEMENT IN CHEMISTRY BY OBSERVING MEMORIZING SKILL IN STUDENTS OF CLASS XI ON RATE OF REACTION TOPIC IN SMK NEGERI 17 SAMARINDA

Nurlaili[1)], Galuh Hayu Widyaningrum[2)]
[1] *Faculty of Teacher Training and Education ,Mulawarman University*
Email: nurlailisyamsul@yahoo.co.id
[2] *Faculty of Teacher Training and Education ,Mulawarman University*

Email: galuhhayu.ghw@gmail.com

ABSTRACT

This study aims to find out: (1) the difference of implementation of inquiry and direct learning model using drill method towards learning achievement in chemistry on rate of reaction topic in SMK Negeri 17 Samarinda, (2) the difference between students who have high memorizing skill in class which utilizes inquiry learning model and class which utilizes direct learning through drill method and students who have low memorizing skill in class which uses inquiry learning model and class which uses direct learning through drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda. The population in this research is all students of class XI Pharmacy in SMK Negeri 17 Samarinda, while the samples being taken is class XI Pharmacy 2 and XI Pharmacy 3, each has 25 students. XI Pharmacy 2 is the class that uses inquiry learning model while XI Pharmacy 3 implements direct learning through drill method. Data collecting technique being used in this research is the test technique. The result is then analyzed by using t-test. From the result, it can be concluded that: (1) there is no difference between the implementation of inquiry and direct learning through drill metthod towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda, (2) there is difference in learning achievement between students who have high memorizing skill in class using inquiry learning model with class using direct learning through drill method and there is no difference in learning achievement between students who have low memorizing skill in class using inquiry learning model with class using direct learning through drill method.

Keywords: inquiry, drill method, memorizing skill, rate of reaction

INTRODUCTION

In a teaching and learning activity, learning process takes very important part to obtain maximum learning achievements from students. Winkel states that "learning achievement is a proof of learning success or the ability of students to conduct his learning activity, in accordance to the achieved quality." In a learning activity, there is processing theory, related to the reception of information. This theory explains about processing, saving, and withdrawing knowledge from the brain. Information processing is strongly related to students memorizing skill. According to Walgito (1985), memorizing skill is the ability to receive or input impressions, save those impression and then withdraw the received impression. In information saving, there are two types of memory, namely long-term and short-term memory. Esteem (in Ismoyo, 2006) explains that short-term memory is one of information saving processes that has temporary nature. The information being stored in short-term memory is originated from sensory memory. Esteem explains further about sensory memory. Sensory memory records information or stimulus which comes from one or more senses, visual through the eyes, hearing through the ears, smelling through the nose, tasting with tongue and caressing with skin. While the long-term memory is a place where knowledge is being stored permanently to be recalled again someday, if it is necessary (Arends, 1997). Tulving (1985), as quoted by Nur (1998), classifies long-term memory into three parts: episodic, semantic and procedural memory. Information contained in semantic memory is facts and general knowledge, generalization of known information: concept, principle or rule and how to use it, and problem-solving skill.

In this study, researchers use inquiry and direct learning model through drill method. The choosing of these models is based on processing theory that is explained before. From the explanation about information processing, in inquiry learning model, the obtained information tends to be stored in long-term memory. This likely to takes place because in inquiry learning model, students are demanded to have higher thinking skill and conduct learning activity by guidance from teacher to solve problems. Therefore, they are able to memorize the information better and so it will be stored in long-term memory storage. Whereas in direct learning model, students tend to see and hear the given explanation by teacher. This makes the obtained information is stored in short-term memory, since the information is only perceived by one or more senses, visual through the eyes, hearing through the ears, smelling through the nose, tasting with tongue and caressing with skin. In order to deal with this issue, researchers combined direct learning model with drill method. In his book, Nana Sudjana states that drill method is an activity of doing something repetitively in order to strengthen the association or to polish a skill so that it becomes more permanent in nature. It is expected that students will be able to absorb the topic better, and store the information in long-term memory.

Based on stages in information processing that are conducted to obtain information which will be stored in long-term memory, the purposes of this research is to find out:

1. The difference of inquiry and direct learning model using drill method towards learning achievement in chemistry by observing memorizing skill in students of class XI on rate of reaction topic in SMK Negeri 17 Samarinda.
2. The difference between students who have high memorizing skill in class using inquiry learning method with class using direct learning model through drill method and students who have low memorizing skill in class using inquiry learning with class using direct learning model through drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda.

RESEARCH METHOD

1. Time and place

   This research took place in SMK Negeri 17 Samarinda, Kadrie Oening Street, during April to May 2015.

2. Population and sample

   The populayion in this research is students from 4 XI Pharmacy classes, academic year 2014/2015 in SMK Negeri 17 Samarinda. From the population, two classes are taken as sample, they are XI Pharmacy 2 (set as experiment class I) and XI Pharmacy 3 (set as experiment class II).

3. Sampling techinque

   In this research, sample is taken using purposive sampling, which is a technique to pick sample by some considerations.

4. Data collecting technique

   Data collecting technique is conducted by using test and observation. The test in this research is aimed to obtain memorizing skill and learning achievement of students.

5. Data analysis

   The data analysis being used in this research are as follow:

   a. Students classfication based on memorizing skill

      Researchers classify memorizing skill test results based on the mean, as the separation value of two groups. High group is those who obtain higher score, while low group is those whose score is lower than or equal to the mean value.

   b. Final score

      Students learning achievement can be seen from students final score which is taken from every post-test conducted at every meeting and the result of regular quiz on rate of reaction topic.

   c. Hypotheses I and II

      The steps that are done to analyze hypothesis I and II are by conducting F-test and t-test after two classes have been treated.

RESULT AND DISCUSSION

The obtained data in this research is students learning achievement on rate of reaction. This is obtained from two experiment classes, they are experiment class I (inquiry learning model) and experiment class II (direct learning model using drill method). The result and discussion can be provided as follow:

1. Hypothesis I

   The difference test between inquiry learning and direct learning model using drill method towards cognitive learning achievement can be seen in table I.

   Table I. The Difference between Inquiry Learning and Direct Learning Using Drill Method towards Learning Achievement

No	Data analysis	*Inquiry*	Direct learning
1.	Mean	80,528	83,28

2.	F_{calc}	1,55
3.	$F_{tab(0,05)}$	1,98
4.	T_{calc}	0,79
5.	$t_{tabel(0,05)}$	2,407

Based on the table above, it can be observed from the t-test, it is known that $t_{calc} < t_{tab,}$ that is 0.79 < 2.407 at significance level 5%, which implies that H_0 is accepted and Hα is rejected. It means there is no difference between inquiry learning and direct learning model using drill method towards students learning achievement in chemistry, by observing memorizing skill in students of class XI on rate of reaction topic in SMK Negeri 17 Samarinda.

The difference between average value of post-test 1, post-test 2 and regular quiz between class that uses inquiry learning model and direct learning model using drill method can be viewed on Figure 2.

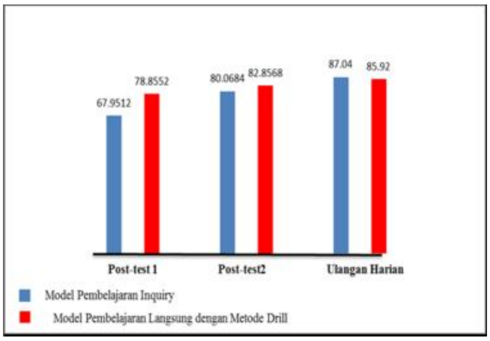


Figure 2. Diagram of Average Score in Inquiry Learning and Direct Learning Model Using Drill Methode

Based on Figure 2 above, it can be seen clearly that the average score between post-test 1, post-test 2 and regular quiz between these two learning models are not significantly different. The average score of both classes is classified as good. This shows that these two learning models are good enough to be applied in rate of reaction topic. In inquiry learning model, students are more actively involved in learning process. In this learning process, students are demanded to have higher order thinking skill and conduct activities by themselves, with guidance from teacher to discover information or to solve problems. This independent activity of students makes them able to memorize the obtained information permanently, or in any other words, they are able to memorize this in longer term, so that the information will be stored in long-term memory. This is also supported by the theory of information processing. Tulving (1985) as quoted by Nur (1998), classifies long-term memory into three parts: episodic, semantic and procedural memory. Information contained in semantic memory is facts and general knowledge, generalization of known information: concept, principle or rule and how to use it, and problem-solving skill. This enables inquiry learning model to make students memorize information better since they ara actively involved in learning process.

While in direct learning model using drill method, the students are given the same treatment repetitively, for instance in practicing problems. As explained by Roestiyah N.K, in Teaching and Learning Strategy (1985), drill method is a activity to do the same thing all over again in order to strengthen association or to polish a skill so it becomes permanent in nature. This repetitive activity will help students to save the obtained information into the long-term memory storage. This makes the two learning models, both obtain good results, since every students in the learning model have their own ways to memorize the information so that the result reaches maximum point.

2. Hypotheses II

In hypotheses II, researchers want to find out whether there are differences between students who have high and low memorizing skill in class using inquiry learning and direct learning model through drill method towards chemistry learning achievement on rate of reaction topic.

a. The difference in learning achievement amongst students based on memorizing skill in high group.

After the inquiry learning model is applied in class XI Pharmacy 2 and the direct learning model using drill method is applied in class XI Pharmacy 3, it is obtained several students who belong to high group. The data is then analyzed. The result can be seen in Table 3.

Table 3. Data analysis result for high group

No	Data analysis	*Inquiry*	Direct learning
1.	Mean	82,64	93,34
2.	F_{calc}	1,51	
3.	$F_{tab(0,05)}$	2,62	
4.	T_{calc}	-3,38	
5.	$t_{tabl(0,05)}$	2,473	

From the t-test, it is known that $t_{calc} < -t_{tab}$, that is -3.38 < -2.473 at 5% significance level, implying that H0 is rejected and Hα is accepted. It can be stated that there are differences between students who have high memorizing skill in class using inquiry learning and class using direct learning through drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda.The average value of students with high memorizing skill from tqo classes can be seen on this figure below.

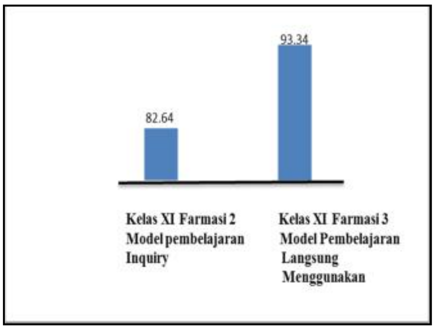


Figure 4. Diagram of average value in students learning achievement from high group.

The average value of students learning achievement in class using direct learning with drill method is higher compared to class using inquiry learning. This can be happened because the implementation of drill method in learning process. There is correlation between drill method and the theory of information processing. In the theory of information processing, the process maintains an information by doing it repetitively and rehearsing it. While in drill method, as explained by Roestiyah N.K. (1985), drill method is an activity to do the same thing all over again in order to strengthen association or to polish a skill so it becomes permanent in nature. This repetitive activity will help students to save the obtained information into the long-term memory storage. This causes the average value of students learning achievement from high group in class using direct learning with drill method is higher compared to class using inquiry learning model.

b. The difference in learning achievement amongst students based on memorizing skill in low group

After the inquiry learning model is applied in class XI Pharmacy 2 and the direct learning model using drill method is applied in class XI Pharmacy 3, it is obtained several students who belong to low group. The data is then analyzed. The result can be seen in Table 5.

Table 5. Data analysis result for low group

No	Data analysis	*Inquiry*	Direct learning
1.	Mean	76,78	72,63
2.	F_{calc}	6,55	
3.	$F_{tab(0,05)}$	2,95	
4.	T_{calc}	0,027	
5.	$t_{tab(0,05)}$	2,539	

From the t-test, it is known that $t_{calc<}$-t_{tab}, that is 0,027 < 2.539 at 5% significance level, implying that H_0 is accepted and Hα is rejected. It can be stated that there are no differences between students who have low memorizing skill in class using inquiry learning and class using direct learning through drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda. The average value of students with low memorizing skill from tqo classes can be seen on Figure 6.

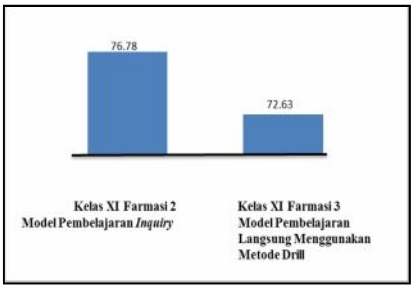


Figure 6. Diagram of average value in students learning achievement from low group

The average value of low group from both classes are not significantly different. The absence of differences is probably caused by the lack of information receiving and saving skill. The ability to receive, save, and recall information has significant influence towards students effectivit, either in receiving learning content or recalling learning topic. When a student has better memorizing skill, it implies he will absorb, pertain and memorize more contents, and then become able to recall and communicate it. In its relationship towards students topic mastery, memorizing skill is consisted of three aspects: (1) the ability to receive and store message into memory; (2) the ability to save the message well in memory; (3) the ability to recall the message. These three abilties are differed amongst individuals. This factor causes students who have low memorizing skill from two classes do not have any significant differences.

CONCLUSION

Based on the result, it can be concluded that:

1. There is no difference between the implementation of inquiry learning and direct learning model using drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda.
2. There are differences between students who have high memorizing skill in class using inquiry learning model and class using direct learning model through drill method, and there are no differences between students who have low memorizing skill in class using inquiry learning model and class using direct learning model through drill method towards learning achievement on rate of reaction topic in SMK Negeri 17 Samarinda.
3. Direct learning model using drill method is a better option to be implemented on rate of reaction topic, compared to inquiry learning model, in order to achieve maximum learning achievement.

BIBLIOGRAPHY

Adegora L. 2012. *Metode Drill*. http:// Adhegora L .blogspot .com/2012/04/Metode Drill.html.DiaksesTanggal 01 April 2015.

Agus.2012.*Pengertian PrinsipdanTujuanMetode Drill*.http://www.sarjanaku.com/2012/04/metode-drill-pengertian-prinsip-tujuan.html. Diaksestanggal 01 April 2015

Ahmadi, Abu danWidodoSupriyanto. 2004. *PsikologiBelajar*. Jakarta: PenerbitRinekaCipta

Arikunto, Suharsimi.2006.*ProsedurPenelitianSuatuPendekatanPraktik*. Jakarta: PenerbitRinekaCipta

Aunurrahman.2012. *BelajardanPembelajaran*. Bandung: PenerbitAlfabeta

Haristanto.Ical. 2011. *KemampuanMemori*.http:// sainsedutainment .blogspot .com/2011/10/kemampuan-memori.html.DiaksesTanggal 13 Februari 2015.

Jensen.Eric. 2011.*PemelajaranBerbasisOtak*. Jakarta: PT.Indeks

Jihad, Asepdan Abdul Haris. 2008.*EvaluasiPembelajaran*. Jakarta: Penerbit Multi Pressindo

Muhammad, Faiq. 2013. *Sintak Model PembelajaranLangsung*.http://penelitiantindakankelas.blogspot.com/2013/04/sintaks-model-pembelajaran-langsung.html. Diaksestanggal 01 April 2015

N.K. Roestiyah. 1985. *StrategiBelajarMengajar*. Jakarta: PenerbitRinekaCipta

Sagala, Syaiful. *KonsepdanMaknaPembelajaran*. Bandung: PenerbitAlfabeta Bandung.

Salmeto.2010.*Belajar &Faktor-faktor yang Mempengaruhinya*. Jakarta: RinekaCipta

SanjayaWina. 2006. *StrategiPembelajaranBerorientasiStandarProses Pendidi*kan. Jakarta: KencanaPerdana Media Group

Susanti.2014.*Model Pembelajaran Langsung*.http://www.informasi-pendidikan.com/2014/01/model-pembelajaran-langsung.html.Diakses tanggal 01 April 2015

Trianto.2009. *MendesainPembelajaranInovatif-Progresif:KonsepLandasan, danImplementasinyapadaKurikulum Tingkat SatuanPendidikan (KTSP)*. Jakarta: KencanaPerdana Media Group

Winkel,1996.*PsikologiPendidikandanEvaluasiBelajar*.Jakarta: Gramedia,

THE INFLUENCE OF THE IMPLEMENTATION OF PROJECT BASED LEARNING LEARNING MODEL USING CHEMOENTREPRENEURSHIP APPROACH ON THE LEARNING OUTCOME AND ENTREPRENEURSHIP INTEREST OF SMA NEGERI 1 SAMARINDA SCIENCE PROGRAM STUDENT ON COLLOIDAL SYSTEM TOPIC IN 2014/2015 ACADEMIC YEAR

Ratna Kusumawardani[1)], Rexy Anderson Tindangen[2)]

[1]*Faculty of Teacher Training and Education, Mulawarman University*

Email: nana_chemistry@yahoo.com

[2]*Faculty of Teacher Training and Education, Mulawarman University*

Email: rexytindangen@gmail.com

ABSTRACT

This research objective was to determine the influence of the implementation of Project Based Learning (PjBL) learning model with chemoentrepreneurship approach on the learning outcome and entrepreneurship interest of SMA Negeri 1 Samarinda student on colloidal system topic. The population was all eleventh grade students of SMA Negeri 1 Samarinda science program, meanwhile the sample was the eleventh grade students of 5th Science program class. This research used one shot pretest-posttest design, which only use 1 class as sample. The influence was determined by comparing the result of pretest and posttest and analyzed by using t test method, meanwhile the learning outcome and entrepreneurship interest improvement category were analyzed by using N-gain method. The results of the implementation of Project Based Learning (PjBL) learning model with chemoentrepreneurship approach showed a significant influence on the learning outcome and entrepreneurship interest of SMA Negeri 1 Samarinda student on colloidal system topic. According to N-gain test, the students' learning outcome on first and second meeting has improved and the improvement is on medium category, meanwhile the students' entrepreneurship interest also improved and the improvement is on low category.

Keyword: Project Based Learning, Chemoentrepreneurship Approach, Learning Outcome, Entrepreneurship Interest, Colloidal System.

1. INTRODUCTION

Colloidal system is one of the chemistry topic that has many concepts. It is often taught by using explaining (lecturing) method and sometimes by instructing students to make a paper. This is suspected due to the perception that colloidal system is less useful on a national exam which is the ultimate test of learning in high school. Whereas, colloidal system concepts is so close to daily life. This fact of course makes the students lose the opportunity to apply the concepts that they received which makes the learning process become less meaningful. To avoid the learning process become less meaningful, using learning model which makes students apply the concepts they have received is crucial.

One of the learning model which is not only give the students an understanding on the concept but also emphasizes the application of the concept is project based learning. In project based learning, students are guided to create a product as the application of the concept that they have received. Project based learning is designed to solve complex problem which is needed by the students in investigation and understanding process. In project based learning, the inquiry starts by expressing a guiding question and invite the students on a collaborative proyek which interpret various subject on curriculum. Project based learning gives students an opportunity to explore topics by using varieties of meaningful ways and to conduct a colaborative experiment. Theoretically and conceptually, project based learing is supported by activity theory. Activity theory states that the basic structure of an activity consist of: (a) the objective, (b) the subject in context, (c) the community, (d) tools and (e) rules. Its application in the classroom is based on active learning activities by "doing" rather than passively receiving knowledge transfered by teachers (Wena, 2010).

Project based learning is also supported by constructivist learning theory, which rest on the idea that the students construct their own knowledge within the context of their own experience. Project based learning is viewed as an approach that creates a learning environment which could encourage students to construct their own knowledge and skills personally. When project based learning was done in a small groups of students, project based learning also theoretically supported by Vygotsky social constructivism theory that provide the foundation of cognitive development through increased intensity of interpersonal interaction. The opportunity to convey ideas, listen to others' ideas, and reflect on their own ideas on others, is a form of individual learning. Interactive process with fellow colleagues to help the process of knowledge construction. From the perspective of this theory, project based learning can help students improve their skills and collaborative problem solving (Wena, 2010).

Learning will be more meaningful if the learning is close to daily life. Learning that is close to daily life can be realized by using a contextual approach. One of the contextual approach that is designed to be used in learning chemistry is chemoentrepreneurship approach, or commonly abbreviated as CEP. The concept of chemoentrepreneurship is a contextual approach, which is an approach that close to daily life in order to motivate students to have an entrepreneurship spirit. Through this approach the teaching of chemistry will be more fun and provide opportunities for students to optimize their potential in order to produce the product. If the students are already familiar with such learning conditions, we will possibly motivate them to entrepreneurship (Supartono in Qudsiyah, 2013). The role of entrepreneurship interest in promoting economic growth must be enhanced given that the interest will eventually be the potential for a person to carry out entrepreneurial activities.

Chemoentrepreneurship is appropriate and can support learning chemistry on colloidal system topic. Through this approach, it is expected that students can apply the concepts on colloidal system topics into a products that have a sale value and have an entrepreneurial spirit so that when graduated from high school, students at least have the competence of entrepreneurship by applying the concepts in colloidal system topic. The indicators of interest in entrepreneurship the researchers wanted to attain were referring to Purnomo (2005) in Agustini (2007), which is: (1) Strong will to achieve the goals and needs of life, (2) Strong belief on their own strengt, (3) honesty and responsibility, (4) physical and mental endurance, (5) Perseverance and tenacity in working and trying, (6) a creative and constructive thinking, (7) oriented to the future, and (8) Dare to take risks.

In this study, researchers were trying to combine project based learning and chemoentrepreneurship approach. The objective is to know the influence of implementation of project based learning with chemoentrepreneurship approach to student's learning outcomes and entrepreneurship interest on colloidal system topic. The implementaton of project based learning with *Chemoentrepreneurship* approach is expected to produce a generation that is not just smart theoretically, but also can apply the knowledge that they received into daily life, especialy in entrepreneurial activities

2. RESEARCH METHODS

This research used a pretest-posttest one shot design, which in this design was only used one class as a sample. Learning outcomes were measured by comparing the results of pretest and posttest at each meeting, while the students' interest in entrepreneurship were measured by comparing the results of questionnaires completed before and after the topic is given. This research was conducted at SMAN 1 Samarinda, the population of this study were all students of XII grade on SMAN 1 Samarinda, while the sample of this research was 5th science program of XII grade on SMA Negeri 1 Samarinda. The obtained data were analyzed to obtain its normality and homogeneity, then followed by t-test to see the difference. The improvement of learning outcomes and entrepreneurship interest then treated with N-Gain Test to determine the criteria of improvement. Normality test, homogeneity test and t test performed with SPSS version 21.

3. Results and Discussion

Results

Here are the learning outcomes and entrepreneurship interest (before and after) data by implementing the project based learning with chemoentrepreneurship approach.

Aspect	Before	After
Learning Outcomes		
a. First Meeting	31,92	79,56
b. Second Meeting	13,26	67,44
Entrepreneurship Interest	69,3%	77%

Table 1. The students average score of learning outcomes and entrepreneurship interest before and after the implementation of project based learning with chemoentrepreneurship approach

Based on research data, it is clear that there was an improvement on students learning outcomes and entrepreneurship interest. The improvement category then determined using N-gain method. Here are the results of N-gain which describe the improvement category of students learning outcomes and entrepreneurship interest

Table 2. N-gain value and improvement criteria

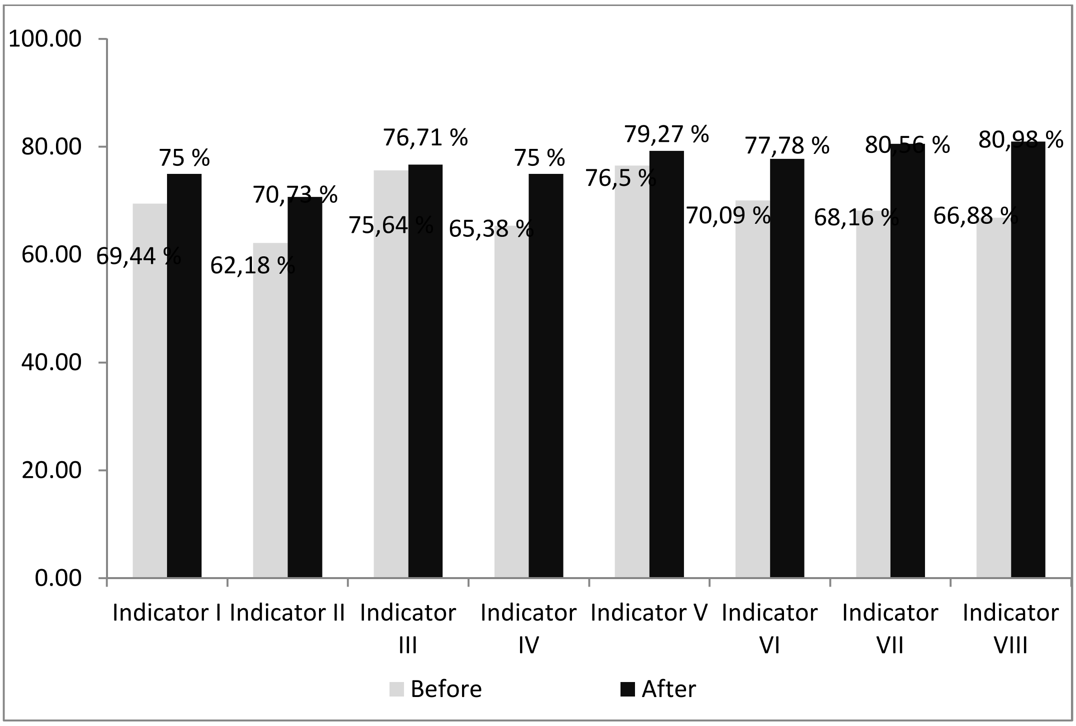
Aspect	N-Gain	Criteria
Learning Outcomes		
a. First Meeting	0,70	Medium
b. Second Meeting	0,62	Medium
Entrepreneurship Interest	0,25	Low

Discussion

The results showed that the implementation of project based learning model using chemoentrepreneurhsip approach gives a positive influence on students learning outcomes and entrepreneurhsip interest. The positive influence were reflected on students pretest and posttest average score at each meeting, where the students first meeting average score were improved from31,92 in pretest to 79,56 on posttest. The same positive improvement also occured on second meeting, where the students second meeting average score were improved from13,26 in pretest to 67,44 on posttest. Note that the average of students final score (74) had passed the criteria of completeness (70) in the school where the research was conducted.

The implementation of project based learning using chemoentrepreneurship approach also gave a positive influence on students entrepreneurship interest. The positive influence were reflected on students questionnaire average score, where the student interest in entrepreneurship generally (for all indicators) increased from 69.3% to 77%. The increase of students entrepreneurship interests for each indicator are reflected in the following figure.

Figure 1. Percentage of students' entrepreneurship interest before and after the implementation of project based learning using chemoentrepreneurship approach



Based on that description, it showed us that teaching chemistry with project based learning using chemoentrepreneurship approach could improve students learning outcome and entrepreneurship interest in learning chemistry on colloidal system topic.

The implementation of project based learning using chemoentrepreneurship approach had advantages and disadvantages.The advantages were:

a. Students' motivation increased. Students were dilligent and work hard to accomplish their project and felt that learning using project is more enjoyable. It was reflected on the students enthusiasm in internal group discussion and in presentation. Besides challenged to find the ideas of colloidal system product, students were also motivated to search for creative ideas in order to produce colloidal system product with economic value.

b. Improvement on problem solving skills, reflected in the result of pretest and posttest on each meeting.

c. Improvement on collaboration. the importance of teamwork within the project required students to develop and practice communication skills. Theories of new cognitive and constructivist asserted that learning is a social phenomenon, and that students would learn more in a collaborative environment. The activities of groups of students solved could help each other problems.

d. Improvement on management skills. It appeared on the student's ability in organizing the project, making the allocation of time and other resources such as equipment to complete the project.

e. Improvement on learning outcomes and entrepreneurship interest, which proved by research data.

The description about the advantages on teaching chemistry using project based learning with chemoentrepreneurship showed that it was able to bring students' enthusiasm. The enthuasism, though was an advantage, also could become a disadvantage. The excessive enthsiasm could make the classroom became a little bit difficult to control. Such thing could led the allocation time increased. There was also an obstacle came from instrument preparation phase, such as making learning plan, pretest and postest. The learning plan, pretest and postest must be designed in such a way that not only highlight the entrepreneurial aspect, but also still be able to direct students to achieve the expected competencies achieved through learning by using chemoentreperneurship approach.

4. CONCLUSIONS

Based on the results and discussion, the conclusions are:

1. Implementation of Project Based Learning using Chemoentrepreneurship approach on colloidal system topic influence SMA Negeri 1 Samarinda student's learning outcomes in positive ways.
2. Implementation of Project Based Learning using Chemoentrepreneurship approach on colloidal system topic influence SMA Negeri 1 Samarinda student's entrepreneurship interest in positive ways.

5. REFERENCES

Agustini, Ferina. 2007. *Peningkatan Motivasi, Hasil Belajar dan Minat Berwirausaha Siswa Melalui Pembelajaran Kimia dengan Pendekatan Chemoentrepreneurship (CEP)*. Tesis. Program Pascasarjana Program Studi Pendidikan IPA Universitas Negeri Semarang

Dimyati dan Mudjiono. 2002. *Belajar dan Pembelajaran*. Jakarta: Rineka Cipta.

Direktorat Pembinaan SMA. 2014. *Pembelajaran kimia melalui pendekatan saintifik*. Direktorat Jenderal Pendidikan Menengah Kementerian Pendidikan dan Kebudayaan.Jakarta

Haniatun. 2007. *Peningkatan hasil belajar siswa melalui model pembelajaran kooperatif Student Teams Achievement Division (STAD) berorientasi Chemoentrepreneurship (CEP) menggunakan praktikum aplikatif berbasis Life Skill*. Skripsi: Tidak diterbitkan

Harun, Yusoff. 2006. *Project Based Learning Handbook*. Kuala Lumpur: Ministry of Education Educational Technology Division

Kadarwati, Sri; Subiyanto Hadi Saputro, Sigit Priatmoko. 2010. *Upaya Peningkatan Hasil Belajar Kimia Fisika 5 dengan Pendekatan Chemoentrepreneurship Melalui Kegiatan Lesson Study*. Jurnal Inovasi Pendidikan Kimia Vol. 4 Nomor 1 Hal. 532-543

Khamdi, W. 2007. *Pembelajaran Berbasis Proyek: Model Potensial untuk Peningkatan Mutu Pembelajaran*. https://lubisgrafura.wordpress.com/2007/09/23/pembelajaran-berbasis-proyek-model-potensial-untuk-peningkatan-mutu-pembelajaran/ , diakses tanggal 25 Februari 2015

Kurniasih, Imas dan Berlin Sani. 2014. *Sukses Mengimplementasikan Kurikulum 2013(Memahami Berbagai Aspek Dalam Kurikulum 2013.* Edisi Kedua. Surabaya: Kata Pena

Lestari, Indah. 2007. *Pengaruh Pemanfatan Software Macromedia Flash MX Sebagai Media CHEMO-EDUTAINMENT (CET) Pada Pembelajaran Dengan Pendekatan CHEMO-ENTREPRENEURSHIP (CEP) Terhadap Hasil Belajar Siswa SMA Pokok Materi Sistem Koloid*. Skripsi. Semarang: FMIPA Universitas Negeri Semarang

Muhibbin, Syah. 2010. *Psikologi Pendidikan dengan Pendekatan Baru*. Bandung: PT. Remaja Rosdakarya

Mulyani, Endang. 2011. *Model Pendidikan Kewirausahaan di Pendidikan Dasar dan Menengah*. Jurnal Ekonomi dan Pendidikan Vol. 8 Nomor 1

Mursiti, Sri; Titi Wahyukaeni, Sudarmin. 2008. *Pembelajaran Dengan Pendekatan Chemo-Entrepreneurship Dan Penggunaan Game Simulation Sebagai Media Chemo-Edutainment Untuk Meningkatkan Hasil Belajar, Kreativitas Dan Life Skill*. Jurnal Inovasi Pendidikan Kimia Vol.2 Nomor 2 Hal. 274-280

Ningsih, R. S. 2007. *Sains Kimia 2*. Jakarta:Bumi Aksara

Qudsiyah, F. H. 2013. Implementasi Praktikum Aplikatif Berorientasi Chemoentrepreneurship (CEP) Terhadap Peningkatan Hasil Belajar Kimia Materi Koloid Siswa Kelas XI. Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Negeri Semarang. Skripsi: Tidak diterbitkan

Sa'adah, N; Supartono. 2013. *Penggunaan Pendekatan Chemoentrepreneurship Pada Materi Larutan Penyangga Untuk Meningkatkan Life Skill Siswa*. http://journal.unnes.ac.id/sju/index.php/chemined, diakses tanggal 25 Februari 2015

Sanjaya, W. 2008. Kurikulum dan Pembelajaran. Jakarta*: Kencana*

Supartono, dkk. 2009. *Pembelajaran Kimia Menggunakan Kolaborasi Konstruktif dan Inkuiri Berorientasi Chemo-Entrepreneurship*. Jurnal Inovasi Pendidikan Kimia. Vol. 3. No.1. 2009, hal 337-344

Suryabrata, S. 2006. Psikologi Pendidikan. Jakarta: PT Raja Grafindo Persada

Susanti, E. 2008. *Pendekatan Project Based Learning untuk Pembelajaran Kimia Koloid di SMA*. Universitas Sumatera Utara. Skripsi: Tidak diterbitkan

Trianto. 2010. Mendesain Model Pembelajaran Inovatif-Progresif. Jakarta: Kencana Prenada Media Group

Wena, Made. 2010. *Strategi Pembelajaran Inovatif Kontemporer Suatu Tinjauan Konseptual Operasional*. Jakarta: Bumi Aksara

PROTOTYPE OF 21$_{st}$ CENTURY ORIENTED COURSE CURRICULUM MODELS ON HIGH LEVEL BOTANY COURSE

HERLIANI

Biology Education Study Program of Faculty of Teacher Training and Educationof Mulawarman University

E-mail:ellieherliani@gmail.com

ABSTRACT

The curriculum is a set of plans and arrangements regarding the objectives, content and learning materials as well as a way of learning that is used as a guide to achieve certain courses.Learning the 21st century demand a change in the orientation of learning is to master the combination of content knowledge, skills, expertise, and proficiency.The 21st century requires the skills knowledge and understanding among all students.Learning and innovation skills of the 21st century is creativity and innovation, critical thinking and problem solving, communication, and collaboration.

Content analysis Model Curriculum oriented courses conducted in the 21st Century: 1) National standards Universities which consists of competency standards, learning content standards, standards of learning and assessment standards of learning, 2) Indonesian National Qualifications Framework which consists of working ability, the ability of knowledge and ability manajereal, 3) Curriculum 2013, which consists of attitudes, knowledge and skills, 4) local wisdom consisting of local knowledge, local skills, and local sources, and 5) 21st century skills which consists of:a) science process skills (formulating the problem, formulating hypotheses, designing experiments, carry out experiments, collect and analyze data, draw conclusions, and communicate), b) thinking skills by using an evaluation tool taxonomy SOLO by classifying the level of ability of students at five levels, namely level prastruktural, unistruktural, multistruktural, rational and extended abstracs, and c) entrepreneurship with elements of self-employed; elements of knowledge, skills element and an element of vigilance.Analysis of the learning experience by using teaching strategies approach Science Process Skills, Problem Based Learning, Enquiry and Cooperative STAD.Products produced teaching Semester Lesson Plan (RPS), Instructional Materials, Student Activity Sheet (MFI) and the Assessment Sheet.The authority to develop or construct effective curriculum appropriate to the circumstances and needs of the region based on the National Education Standards in accordance with Permendikbud number 49 in 2014.

Keywords: Curriculum Models, 21th Century

PRELIMINARY

Indonesian Presidential Regulation Number 8 of 2012 on the National Qualifications Framework Indonesia (KKNI) Chapter I of Article 1.1 and Article 1.2 states that KKNI is a framework penjenjangan competence and qualifications that can reconcile, equalize, and integrate the field of education and the field of vocational training and work experience in order granting recognition of work competence in accordance with the structure of employment in various sectors. The achievement of learning is the ability acquired through the internalization of knowledge, attitudes, skills, competencies, and the accumulation of work experience (Deputy of Public Welfare, 2012: 2).

Exposure to the Education Minister at the time of socialization Curriculum 2013 in Bandung on March 16, 2013, stated that there are four (4) national education policy that became internal and external challenges, namely: 1) the arrangement patterns of thought and governance, 2) the deepening and expansion of the material, 3) strengthening processes and 4) adjustment of the curriculum load (National Minister of Education, 2012).

Regulation of the Minister of Education of the Republic of Indonesia Number 49 of 2014 on National Education Standards include: 1) the scope, 2) competency standards, 3) content standard, 4) standard processes, 5) assessment standards, 6) standard researcher, 7) standard means and infrastructure, 8) management standards and 9) standard funding and financing. The 21st century skills are a set of capabilities that must be owned by the students in order to successfully live in the 21st century the century of the developing world is getting flat, no longer recognize borders. At that time everyone had to show independence, but can cooperate with others and be able to compete (Binggeli, 2011).

Experts argue that students who are still aged 0-20 years including students will live in the century prosecuted as independent thinkers, problem solvers, and decision makers. Schools should focus not only on instilling the fundamentals of science, but also to ensure that students gain a new form of skills, the ability to reason, and thinking skills (Silva, 2009: 630). Furthermore, Duncan (2010) in Riley (2010: 5) states that in the 21st century, educators must be given and ready to use technology tools, must be collaborators in the learning continuously seek knowledge and acquire new skills along with the students.

Terkait dengan pembelajaran abad 21 Prayitno (2010: 6) menyatakan bahwa terjadi perubahan orientasi dalam pembelajaran yaitu: (1) shift the paradigm of learning the hidden assumption that knowledge can be transferred intact from the brain / mind teachers to the brain / mind of students, learning becomes more empowering all aspects of students' abilities; (2) the learning paradigm centered on the teacher (teacher centered learning) towards student-centered learning (student centered learning), self-learning (self directed learning) and self-understanding; (3) learn to 'memorize' concept towards studying 'find' and 'build' (construct) its own draft, which is proven to improve students' ability to think critically, critical, creative, and skilled solve the problem; (4) shifts from individual learning classical towards cooperative and collaborative learning groups who not only teach thinking skills alone but also be able to teach students other skills. As proposed by the Minister of Education (2013: 72) that the theme Curriculum 2013 is a curriculum that can produce human Indonesia productive, creative, innovative, affective through strengthening, attitudes, skills and knowledge are integrated.

Competency framework of the 21st century to improve the learning process to achieve proficiency: (1) Skills lives and careers (life and carrier skills) consisting of: 1) be flexible and adaptive, 2) took the initiative and independent, 3) skilled social and cultural, 4) productive and accountable, 5) leadership skills and responsibility; (2) learning and innovation skills (learning and innovation skills) consisting of: 1) creative and innovative 2) critical thinking in solving problems, 3) communication and collaboration skills; (3) the capacity to obtain information, media, and technology (information media and technology skiils) consisting of: 1) information literacy, 2) Media literacy, 3) ICT literacy (Tucson, 2009: 1).

This framework suggests that the learning process is not enough just to increase knowledge (through core subjects), but must be equipped with the ability to think creatively and critically, strong character (responsible, social, tolerant, productive, adaptive). In addition, it is supported by the ability to utilize technology, collaborate, and communicate. The description above the learning demands of the 21st century change in the orientation of learning is to master the combination of content knowledge, skills, expertise, and proficiency. The 21st century requires the skills knowledge and understanding among all students. Students can think critically, solve problems, communicate effectively and collaborate (Tucson, 2009: 520). Previous Kahl (2008: 3) states that the theme of learning and innovation skills of the 21st century is creativity and innovation, critical thinking and problem solving, communication, and collaboration.

Demographic bonus as the capital of Indonesia in 2010 until 2045 in the form of human resources productive age abundant both competent which is a development capital and incompetent will be the burden of development hence HR incompetent to be transformed through education by improving the curriculum, carry out research through education by improving the curriculum, carry out action research (PTK), providing infrastructure and supported with funding and good management (Education, 2013: 27).

Providing education paradigm shift from centralization to decentralization and the autonomy of educational push for changes and updates on some aspects of education, including aspects of the curriculum. In this regard, the curriculum at the College of concern and new ideas, so it had a policy changes. One of the changes in the field of education is very strategic with regard to curriculum development. In this case, the College has the authority to develop or construct effective curriculum appropriate to the circumstances and needs of the region based on the National Education Standards in accordance with Permendikbud number 49 in 2014. This may give a more realistic expectation to improve the quality of education for the realization source quality human who has high competitiveness in the midst of global competition increasingly sharp.

Universities authority in drafting or developing the curriculum requires the readiness of human resources professionals in its implementation.

Curriculum development plays an important role in science process skills proficiency. The implications of the changing demands on the education system is the need for changes in the curriculum and the orientation of the learning process in the classroom. It is necessary to better equip learners have the ability to face the challenges of life in the future independently, intelligent, critical, rational and creative. Learning in the context of preparing the human resources of the 21st century must be referring to the concept study launched by the Commission of UNESCO in the form of "the four pillars of education": learning to know ("learning to know"), learning how to do something ("learning to do"), learn to live together as a basis to participate and cooperate with others in the overall activities of human life ("learning to live together"), and learning to be herself ("learning to be" (De Vito 1989: 120). The learning model is needed is capable of generating the ability to learn (Joyce & Weil; 1996: 7), not only acquired some knowledge, skills and attitudes, but more important is how the knowledge, skills, and attitudes that obtained by students (Zamroni 2000: 30; Semiawan 1998: 13).

RESEARCH METHODS

This study uses a Research and Developmen (R & D), with a flow of 3-D models, namely: the definition phase (define), designing (design), development (develop). Selection of 3-D models as a method of R & D in this study was based on the consideration of 3-D models equipped with relatively detailed explanation on each step, as well as 3-D models have also been commonly used in a variety of research development.

This study is called developmental research because this research focuses on the development of curricula oriented to the 21st century are expected to produce students as a teacher candidates managed to live in the future, have the skills to think, able to exploit the natural resources by emphasizing local knowledge through the development of entrepreneurship, strong character (responsible, social, tolerant, productive, capable of providing adaptive provision) and the use of information and technology, collaborate, and communicate and synchronize education with the needs of the workforce.

In the draft development stage products will be developed a draft Model Oriented Curriculum Course 21st Century Botany Course on High input in the initial survey and analysis needs. Components of the model curriculum developed include: Profile graduates biology education, Profile Prodi, Competency, Material Assessment, Mapping Courses, Learning Outcomes Studies Program, Learning Outcomes Course Botany High. Product resulting from the development is Semester Lesson Plan (RPS), teaching materials, and the Student Activity Sheet (MFIs). In simple steps and targets are achieved on each stage of the study visualized in the following flow-chart

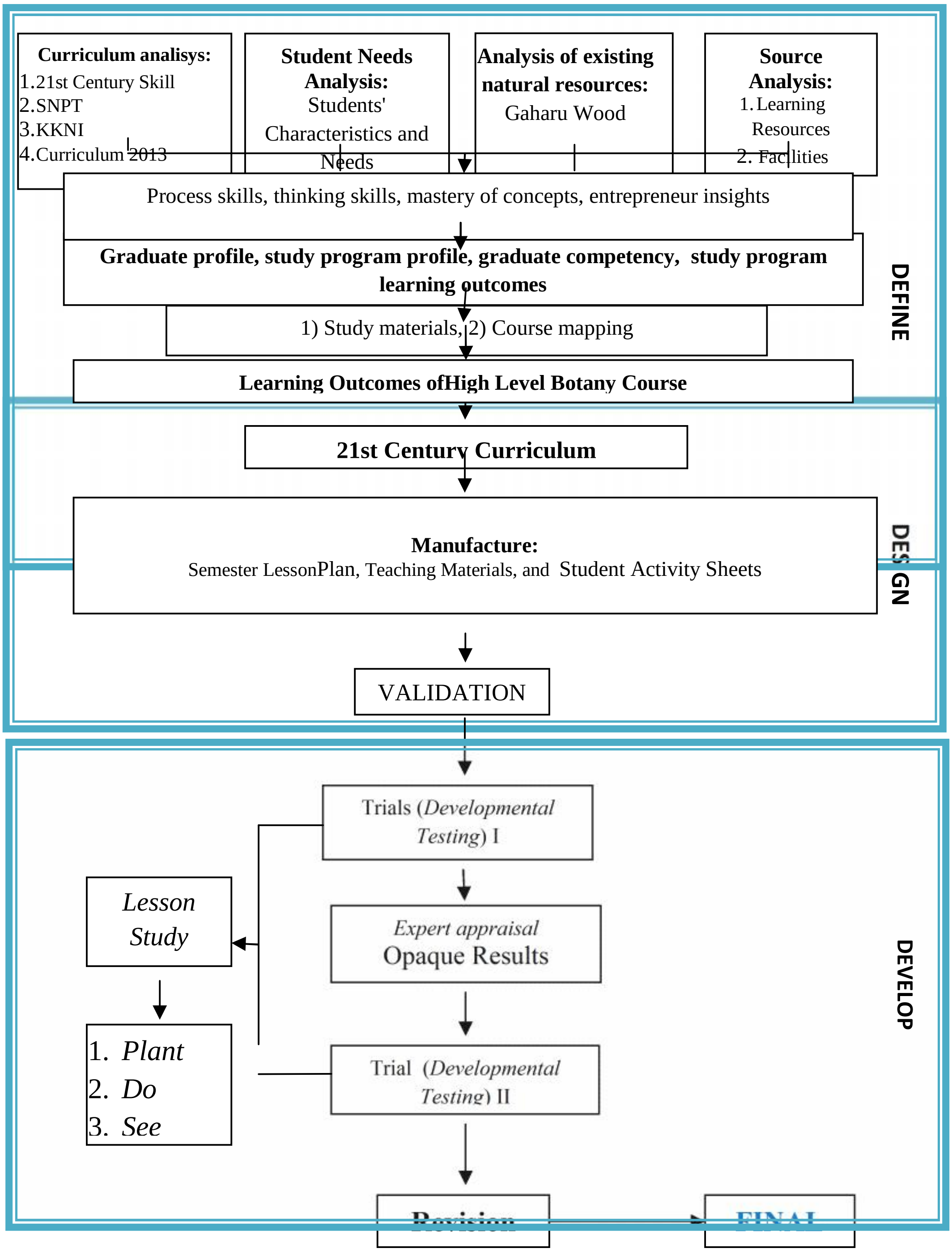


Figure 1. The Series of Research Activities 21st Century-Oriented of Curriculum Development Models

In the test phase product validation experts "Book Prototype Model Oriented Curriculum Course 21st century gardener at the Botanical Eye Level High". Validation of experts for the purpose of reviewing the draft of the product. Experts involved consists of three experts curriculum specialists, with a minimum qualification of a doctorate in their respective fields. After experts said the draft worth continuing with the test product users by the lecturer who teaches courses in Botany High.

The expert test data analyzed by descriptive. Experts give an objective assessment of the various aspects related to the model curriculum, by providing a check mark (√) in accordance with the statement given by the criteria of yes and no.

Furthermore, to facilitate the revision and refinement of the model curriculum, the validator can give suggestions in the space provided or directly on the books of the prototype included.

RESULTS AND DISCUSSION

In this section will be presented "Model-Oriented Curriculum Course 21st Century". Curriculum development model refers to a model curriculum differentiation by modifying of the opinion Rezulli models.

In this section will be presented "Model-Oriented Curriculum Course 21st Century". Curriculum development model refers to a model curriculum differentiation by modifying of the opinion Rezulli models. Scope curriculum in the curriculum model of the 21st century-oriented courses in the subject of Botany High load: content, experiences, and products provided to students as a biology teacher candidates. Student as teacher candidates who managed to live in the future have the skills to think, able to exploit the natural resources through the development kewiraswataan, strong character (responsible, social, tolerant, productive, able to provide stock adaptive) and take advantage of technology and information, collaborate, and communicate and synchronize education with the needs of the workforce. Following the model curriculum of the 21st century-oriented subjects in Figure 1.

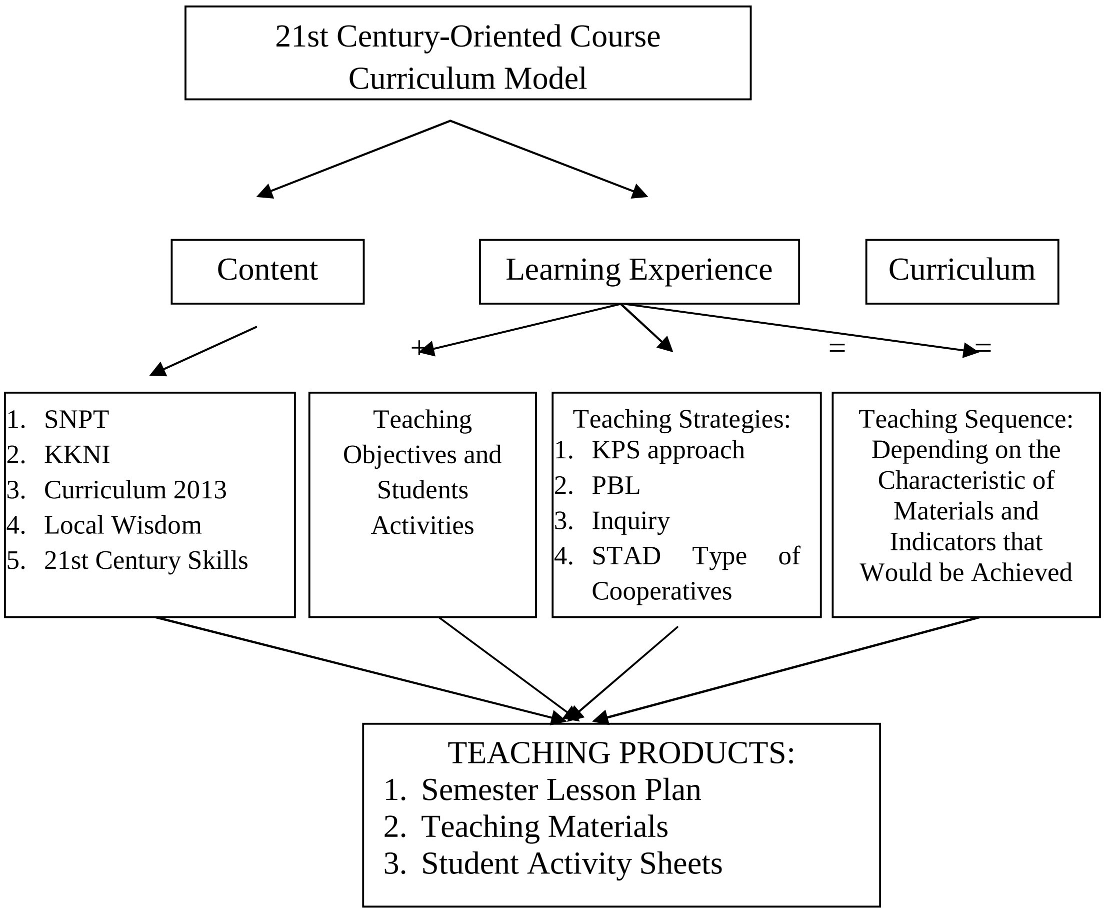


Figure 1. 21st Century-Oriented Course Curriculum Models

The model curriculum developed a model curriculum in accordance with the demands of 21st century skills that have the science process skills, thinking skills, entrepreneurship and refer to: 1) National Standards for Higher Education (SNPT) which include: the scope, competence of graduates, content, process, and assessment. 2) The Indonesian National Qualifications Framework (KKNI) (National Qualification Framework). Student of biology as a prospective teacher education program S-1 by KKNI categorized as level 6 with Learning Outcomes (learning outcomes) on the Work Capability (KK), Mastery of Knowledge (PP) and Managerial Capabilities. 3) Curriculum, 2013, namely: attitude terhatap God, attitudes towards themselves and the environment, knowledge and presentation knowledge, 4) local knowledge by utilizing commodity forest products, and 5) skills of the 21st century which includes science process skills, thinking skills, able to utilize sources kewiraswataan natural resources through the development of strong character (responsible, social, tolerant, productive, able to provide stock adaptive) and take advantage of technology and information, collaborate, and communicate and synchronize education with the needs of the workforce.

Curriculum in Universities of concern and new ideas, so it had a policy changes. In this case, the College has the authority to develop or construct effective curriculum appropriate to the circumstances and needs of the region based on the National Education Standards in accordance with the number 49 in 2014. Permendikbud education courses biology curriculum contains profiles of biology education courses that includes a) Vision, mission and objectives; b) Graduate Profile and Competency containing common competency standard S1 graduate education biology, specifically institutional competency standard S1 graduate biology education and competency standards S1 biology education (adjusted for KKNI level 6); c) Content Learning; d) Learning Process load characteristics of the learning process, the learning process planning and execution of the learning process; e) Assessment of Learning; f) The achievement of learning and the learning element; g) relationship with the learning outcomes 4 teacher competence; h) Draft structural biology education course curriculum includes study materials, mapping the learning outcomes of study materials biology education courses, course curriculum structure and distribution of courses of study program.

The recapitulation of the validation of the prototype book "Model Curriculum oriented subjects 21st Century Botany Course In High" as in the following table:

Table 1. The Observation of Prototype 21st Century-Oriented Course Curriculum Models of Botany Course In High-evaluated from several aspects

NO.	ASPECT OF ASSESSMENT	MATERIALIZE					
		VALIDATOR					
		1		2		3	
		Yes	No	Yes	No	Yes	No
Components of Feasibility Content							
1.	The suitability of the curriculumwiththe National Standard of Higher Education: a. Scope Baseline Includes: 1. Study Program Profile formulated so that the formulation of jobs occupied by graduates after completing the study. 2. Vision is formulated as an ideal conditions to be achieved in the future. 3. The mission formulated in the form of tasks to be performed by the	√ √ √		√ √ √		√ √ √	

NO.	ASPECT OF ASSESSMENT	MATERIALIZE VALIDATOR					
		1		2		3	
		Yes	No	Yes	No	Yes	No
	study program includes at less Tridarma Universities (education, research, and community service). 4. The goal is formulated as an estuary of the mission can be something that is achieved after the mission carried out.	√		√		√	
	b. Competency standards expressed in learning outcomes, adjusted for KKNI (including attitudes, general skills, knowledge, and skills).	√		√		√	
	c. Learning content standards include the depth and breadth of the material refers to the learning outcomes of graduates from KKNI.	√		√		√	
	b. Standards of Learning Process is the implementation of learning to acquire the learning outcomes of graduates, covering: 1. Characteristics of the learning process 2. Planning of the learning process 3. Implementation of the learning process	√ √ √		√ √ √		√ √ √	

NO.	ASPECT OF ASSESSMENT	MATERIALIZE VALIDATOR					
		1		2		3	
		Yes	No	Yes	No	Yes	No
	4. Burden of student learning	√		√		√	
	c. Standard learning assessment process includes assessment and student learning outcomes adequacy indicators	√		√		√	
2.	Conformity with KKNI curriculum that consists of a description of the general qualification for all levels and qualification level 6, include: a. Work ability	√		√		√	
	b. Knowledge mastery	√		√		√	
	c. Managerial capability	√		√		√	
3.	The curriculum has to accommodate the characteristics of the school curriculum (Curriculum 2013) that put an emphasis on attitude, knowledge, and skills.	√		√		√	
4.	The curriculum has to accommodate local wisdom, the use of local resources, local skills, local knowledge and good practices based on the local level.	√		√		√	
5.	The curriculum has been to accommodate the development of 21st century skills include: a. Science Process Skills	√		√		√	
	b. Think ability	√		√		√	
	c. Train proficiency / learning skill and innovate	√		√		√	

NO.	ASPECT OF ASSESSMENT	MATERIALIZE VALIDATOR					
		1		2		3	
		Yes	**No**	**Yes**	**No**	**Yes**	**No**
	(creative and innovative, critical thinking, communicating and collaborating)						
	d. Shaping information literacy, media, and technology.	√		√		√	
	e. Forming life skills and provide supplies in career development.	√		√		√	
	f. Based research	√		√		√	
6.	Suitability of learning outcomes and learning elements, including: a. UNESCO's "The Four Pillars of Education" and the National Education of Indonesia, that are: 1. Learning to believe and to convince the almighty God 2. Learning to Know 3. Learning to do 4. Learning to live togetheras a basis to participate and cooperate with others in the overall activities of human life 5. Learning to be	√		√		√	
	b. Kaitan capaian pembelajaran dan element pembelajaran, that are: 1. Learning achievement of general qualifications. 2. The achievement of learning courses 3. Learning achivement as	√		√		√	

NO.	ASPECT OF ASSESSMENT	MATERIALIZE VALIDATOR					
		1		2		3	
		Yes	No	Yes	No	Yes	No
	a characteristic of higher education						
7.	Have adopted the curriculum development needs four competence of teachers (paedagogik, professional, personal, and social)	√		√		√	
8.	Suitability draft of structural biology education curriculum has been developed, include: a. Study materials containing linkages field of study with learning outcomes and credits	√		√		√	
	b. The achievement of learning outcomes of courses and lectures teaching biology education	√		√		√	
	c. Mapping the learning outcomes of study materials biology education courses	√		√		√	
	d. The curriculum structure of biology education courses	√		√		√	
	e. Identity of courses	√		√		√	
Component of Learning Experience							
1.	Student learning experiences and activities developed in science skills to achieve the goal of teaching.	√		√		√	
2.	Relevant learning strategies to achieve the goal of teaching and student activity	√		√		√	
Teaching Product components, resulting in:							

NO.	ASPECT OF ASSESSMENT	MATERIALIZE VALIDATOR					
		1		2		3	
		Yes	No	Yes	No	Yes	No
1.	RPS	√		√		√	
2.	Teaching materials	√		√		√	
3.	LKM	√		√		√	
4.	Assessment sheet	√		√		√	
Linguistic components							
1.	Legibility	√		√		√	
2.	Clarity Information	√		√		√	
3.	Conformity with the good and right of Indonesian rule	√		√		√	
4.	Utilization of languages effectively and efficiently (clear and concise)	√		√		√	
Presentation component							
1.	Curriculum development is supported by a description of national goals	√		√		√	
2.	Benefits clearly structured curriculum development and objectives can be achieved	√		√		√	
3.	Overall curriculum developed in accordance with the 21st century skills	√		√		√	
Total							
Percentage		100 %		100 %		100 %	

Based on observations in Table 1 it can be seen that the percentage of feasibility feasibility on various aspects of 100 percent fine on the feasibility aspect of this component, the component learning experience, teaching product components, linguistic components, and presentation components.

THE STUDY OF MOTIVATION STUDENT WITH VIRTUAL LAB IN TITRATION

Muhammad Iksan
Graduated Chemistry Mulawarman of university education

ABSTRACT

Research has been done on the Virtual Labs as a limited means of chemical laboratories in schools, this study aims to determine how much student motivation in the material titration using a virtual lab. In the acid-base titration study using virtual labs can motivate students more enthusiastic in learning teaching activities. The result is obtained after a study conducted using virtual labs and data obtained from the questionnaire and interview. After doing learning with virtual labs can be concluded motivation of students categorized as very high.

A. INTRODUCTION

Subjects Chemistry is one of the science subjects contained in secondary schools atas.kimia the subjects contained therein theory scientific theory and practicum students have to do to meet success indicators such material. High school or its equivalent in learning chemistry should be able to meet the demands of science so that the subject matter of this chemical must be accompanied by practical. But unfortunately there are many public and private schools that do not have adequate infrastructure to support the achievement of the indicators are not learning because teachers only teach the theoretical course and leave the lab, it is expected to affect the motivation of students are in the learning process chemistry. Chemistry lab that can not be implemented because the infrastructure is expected to be overcome with the help of software chemistry so that students still able to understand practical activities virtually, Concern teachers and researchers to this problem so is necessary for students to have a passion when following materials chemical materials which actually should be presented to the lab, but have limited facilities and infrastructure The use of software and technology is expected to increase the motivation of students to learn on the subject of chemistry should use the laboratory, it is estimated to be very effective use of visual laboratory that can replace the function of the real laboratory. The studies that are relevant to the research that has been done by cengiz Tuysuz in the study entitled "The Effect of Virtual Laboratory on Students Achievement and Attitude in Chemistry" concluded that the use of computers is suitable as a science learning. Facilitate teacher because teaching is enriched with visual presentation software that scientific concepts are difficult and abstract and concrete principles and can be understood by following the appropriate learning. Lucilia Domingues, Isabel Rocha, et al. in a study entitled "Virtual Laboratories In (Bio) Chemical Engineering Education" concluded that the visual lab gives students learning concept includes basic experiments, collecting the underlying experimental basis, pre-visualization (videos, simulations) and manufacturing data.

Virtual labs will increase the effectiveness and independence of students in the laboratory, as well as the results of the analysis and report writing.

B. THE GOALS

As for the main purpose in this study to determine how much students' motivation in learning using a virtual chemistry labs in class XI student of SMK Health Samarinda.

C. SUBJEC TRESEARCH

The subject of this research is a class XI student of nursing health smk Jamiatul muttaqqin, these students totaled 40 students.

D. METHODS

This research was conducted with a qualitative-quantitative approach, so as to obtain data that can be measured using questionnaires and interviews with students who have been given a lesson by using the Virtual Labs. As for research steps in this article begins with the observation of the student, giving tutorials use of virtual labs , having carried out activities with the virtual learning labs, the students were given a questionnaire with a scale linkert the highest five answer choices and the lowest one answer choice, after the data obtained questionnaire then conducted interviews with students to support data questionnaire has been answered. For the calculation of scores on the questionnaire can be determined by dividing the amount of raw data questionnaire with a maximum score is then multiplied a hundred persen.sedangkan interviews can be treated by reducing the data, displaying the data and conclusions (Sugiyono, 2011).

E. RESULT AND DISCUSSION

Based on the score of the questionnaire obtained from 40 students smk health Jamiatul Muttaqin can be averaged results of the questionnaire are classified as very appropriate, it may mean that students have a higher motivation when use of Virtual Labs, because they are more active and innovative to develop themselves and their group. These results are supported by interviews conducted with teachers, students, and principals, students basically requires real lab but schools that do not yet have the infrastructure memng become the main obstacle, a virtual laboratory that is the alternative when no real laboratory. Students are very enthusiastic to understand the theory and apply it in a virtual lab so that they become more eager to learn more.

They expect not only the use of virtual labs in the titration of acids and bases but also in other chemical materials. But the school is expected to continue to fight for the chemical laboratory facilities in real schools.

F. CONCLUSION

Motivation of students on the use of Virtual Labs categorized as very high as evidenced by the increasing involvement of the student learning outcomes dann during the learning process

G. REFERENCES

Amalia, Rifqi. 2010. Implementation of Model Learning Cycle (LC) 5 Phase Assisted Map Concept of Scientific Work To Improve Ability and Achievement studied Physics Grade XI IPA-2 SMAN 10 Malang year 2009/2010. Essay. Malang: Physics Education Study Program, State University of Malang.

Asmani, Jamal M. 2011. Education Research. Jogjakarta: Diva Press Astuti. Practical Hints 2007. Analysis of Biological Materials. Yogyakarta: Jurdik Biology Faculty UNY Bogdan, R. C., and Biklen, S.K..1998. Qualitative Research in Education. America: A Viacom Street. Bryce, TGK, McCall, J, MacGregor, J, Robertson, IJ, and Weston, RAJ 1990. Techniques for Assessing Process Skills in Practical Science. Teacher's Guide. Heinemann Educational Books Ltd., Oxford-London.

Carin, A.A, and Sund, R.B. 1989. Teaching Science Discovery Trough. Columbus: Merrill Publishing Company. Dawson, Chris (Chris J). 2006. Beginning Science Teaching. Longman Cheshire. National Library of Australia. Accessed on 26 September 2013 Mone. 2003. The 2004 curriculum Competency Standards Subjects Chemistry High School and Madrasah Aliyah (Online), www.gobookee.org, accessed 21 November 2013).

Domingues, L., Rocha, I, Dourado, F., Alves, M., Ferreira, C. 2010. Virtual Laboratories in (bio) chemical Enginering Education. Education for Chemical Engineers. Volume 5 E22-e27 www. Elsevier.com. Accessed on March 17 2015.

Emzir. 2010. Education Research Methodology. Jakarta: Rajagrrafindo

Farida, Rochayati. 2002 High School Chemistry Class 2. Bandung: PT Youn

Rosdakarya. Hamalik, Oemar. 1992. Supervision and Curriculum Development Administration. Bandung: CV. Mandar Maju Hamalik, Oemar. 2003. Teaching Planning Systems Based Approach. Jakarta: Earth Literacy

Hamalik, Oemar. 2009. Teaching and Learning. Jakarta: PT Earth Literacy

Isman, 2011. Methods Experimental / experimentation (Experimental Methods). Available on http://gurukelas.com/2011/07/,etode percobaaneksperimen-experimental-methods.html Koento Wibisono, S. et al., 1997. The Philosophy of Science as the Basis for Development of Science. Graduate Faculty UGM Mahmud. 2011. Educational Research Methods. Bandung: PustakaSetia Majid,

Abdul. 2013. Learning Strategies. Bandung. Teens Rosdakarya. Mellado, R, Mayen, IM, Amaro, RR, Montoya, R M. 2013. Preparing Students for the Laboratory by Means of Virtual Labs. Journal of Chemical Education Laboratory .Volume 1 Issue 2 Page 19 - 24. Available at www. JLCE.com. Accessed on May 16, 2015 Moelong, L. J..2006. Qualitative Research Methodology. Bandung: Rosda

Mukhtar. Practical 2013. Qualitative Research Methods. Jakarta: Reference

Mulyadiharja, S. 2008. MFI Microbiology. Singaraja: Biology Education Studies Program, STKIP N Singaraja Purwanto, Ngalim. 2004. Educational Psychology. Bandung: Teens Rosdakarya. Purwanto, Ngalim. 2011. Educational Psychology. Bandung: Teens Rosdakarya Son, N. 2011. Research Development. Jakarta:

RajaGrafindo Razi, Pakhrur and Nailil H, Ramli. 2008. Development of ICT-Based Virtual Laboratory Work To Improve Scientific Competence Students in Learning High School Physics Padang. Padang: UNP.

Razi, Pakhrur. 2013. Relationship With Work Scientific Student Motivation in Learning Physics Using Virtual Laboratory Classroom X SMAN Padang. Journal of Information

Technology & Education VOL. 6 NO. 2 September 2013 ISSN: 2086 to 4981 p. 119-124.
Rodrigues. 1997. "Optimizing The Shape of Mechanical Elements and Structures". copyright by Marcel Dekker, Inc. New York-Basel-Hong Kong. Spiritual,
Ahmad and Abu Ahmadi. 2007. Teaching Management. Jakarta: Rineka Reserved Rusman. 2012. Models of Learning. Depok: PT Persada RajaGrafindo
Samsiarti, Endang ,. 2004. Material Chemistry Class 2 high school. Surabaya: Discourse Gallery Surabaya. Santoso, Singgih & Tjiptono, Fandy. 2002. Marketing Research Concepts and Applications with SPSS. Jakarta: PT Elex Media Komputindo. Sardiman AM. 2008. Interaction of Teaching and Learning and Motivation. Jakarta: King Grafindo Persada.
Sarwono, Jonathan. 2011. Mixed Methods Research Merging Method Quantitative and Qualitative Research Properly. Jakarta: PT Elex Media Komputindo. Silalahi, Gabriel Amin. 2003. Research Methodology and Case Studies. Sidoarjo: CV. Citramedia.
Siswomihardjo, Koento Wibisono. Meaning 1996. According to the Development of Philosophy Positivism Auguste Comte. Yogyakarta: Gadjah Mada University Press.
Soni, Ms. Shweta & Katkar, M.D. 2014. Survey Paper on Virtual Lab for E-Learners. International Journal of Innovation in Engineering Application or et Management (IJAIEM) Volume 3, Issue 1. Available on http://www.ijaiem.org/volume3issue1/IJAIEM-2014-01-13-027.pdf. Accessed on March 17 2015. Sueratno and Arsyad L. 2003. Research Methods for Economics and Business. Yogyakarta: UPP AMP YKPN
Sugiyono. 2005. Understanding Qualitative Research. Bandung: PT. Tarsito
Sumi, Hudiono. 2006. Reference Model Learning Basic Kealamam Ilmi. Padang. Ministry of Education. Suprijono Agus. 2009. Cooperative Learning Theory and Applications PAIKEM. Yogyakarta: Student Library
Supriyadi, Dedi, 2000. Anatomy in the School Book Indonesia.Yogyakarta: ideology Karya Nusa Tuysuz, Cengiz. 2010. The Effect of Virtual Laboratory on Student Achievement and Attitude in Chemistry. Online International Journal of Educational Sciences, 2 (1), 37-53. Available on www.iojes.net. Accessed on March 17 2015. Uno,
Hamzah B. 2008. Motivation Theory and Measurement Analysis in the Field of Education. Jakarta: Earth Literacy
Walizer, Michael H & Wienir, Paul L. 1993. Methods of Analysis and Research for Relationship. Jakarta: Erland.
Widoyoko, EP, 2013. Preparation Technique Research Instruments. Yogyakarta: PustakaPelajar
Winkel. WS, 1983, Educational Psychology and Evaluation of Learning, Jakarta. Scholastic. Yaumi, Mummad. 2013. Principles of Learning Design. Jakarta: Kencana