# The Development of Learning Media KONELA (Configuration Electron Aufbau) in Learning Chemistry

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# The Development of Learning Media KONELA (Configuration Electron Aufbau) in Learning Chemistry

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**Abstract.** The development of learning media KONELA (Aufbau electron configuration) as a learning media has been carried out. The study aims to develop electron configuration learning media, measure their quality and effectiveness. The development process uses Research and Development (R & D) methods from Borg and Gall. The learning media KONELA were made with indicators of the sequence of charging electron configurations with lights. Based on the assessment by the validator, the quality of KONELA was very good and applied positively in learning based on the measurement of students' mastery of concepts. Learning by using KONELA was more effective than two dimensional Aufbau bridge principle, with an increase in student learning outcomes N-Gain 0.63 in the experimental class that was learning by using KONELA and 0.42 in the control class that was learning with two dimensional Aufbau bridge principle.

## INTRODUCTION

The educational process in the 21st century was expected not only to focus on aspects of knowledge but also to form the balance between attitudes and skills that can be reflected in real life. In chemistry learning, the learning objectives will be achieved if the learning process was carried out optimally using appropriate learning approaches, methods, and media [1]. The process of learning chemistry should not only use conventional methods but must involve students actively in the learning process, so students can construct knowledge through learning experiences gained. Knowledge which is obtained through the construction process will provide deep meaning so that the material will be more mastered by students. Simulation or experimentation was needed to provide a direct learning experience for students[2]. Students will get a direct learning experience if learning was done by using appropriate learning media. The positive impact of the use of learning media includes (1) the delivery of learning becomes more interesting, (2) learning becomes more interactive, (3) explaining abstract material objects to be concrete [2]. The problem that occurs in chemistry learning was the lack of available learning media that can simulate the sequence of filling electron configurations according to the Aufbau principle. In general, the media used in schools was electron configuration material based on the Aufbau principle were two-dimensional media that were displayed via powerpoint slides, digital printing images or blackboard. There was a lack of two-dimensional media that only emphasizes on the perception of the visual sense. The solution to overcome the problem was to use media that can simulate electron charging sequences based on the Aufbau principle.

The media developed were props that can be used for electron configurations. The media was using a switch that was connected with an LED (Light Emitting Diode) lamp. Marbles as electrons. When the marbles hit the switch, the LED light will turn on. Lightening of the lights was the indicator of the sequence of charging electron configurations according to the Aufbau principle so students can easily determine by the electron configuration. The advantages of the developed media were playing motion so that it can be used to clarify the concept of electron charging according to the Aufbau principle, the existence of symbols in the form of LED lights that turn into stimulation or sensory memory information that has meaning so the students will further understand the concepts that were ultimately expected to be transferred into long-term memory of the students.

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## METHODS

Subjects of the research were 62 students of X Analysis and Industry from SMKN 1 Bontang. The objective of the research was the quality of media in the learning process of configuration electron topic. Research and development method was the Borg and Gall that produces a product in the form of KONELA learning media.

### Instrument

The instruments were questionnaires, observation sheet, and evaluation sheet. The questionnaire was given to experts of learning material and learning media as well as learning practitioners. This validator questionnaire aims to find out the validity of the learning media that researchers have made so that it can be tested on the chemistry learning process. The observation was carried out to find out the activities of students in using KONELA learning media. This observation was conducted by researchers and chemistry subject teachers from the study schools who also acted as observers when the media was used in the learning process in the classroom. Observation sheet was given to students with the aim to find out the mastery of concepts between students of the experimental class with learning using KONELA media and control classes with learning using the 2-dimensional Aufbau bridge media.

Measurements were (1) validity to measure of the quality and feasibility of the media, (2) the effectiveness of media by looking at the increasing mastery of students' concepts by using KONELA media compared by two-dimensional media used and positive responses of students in learning. The quality of the media can be seen from the validity and practicality of the media by using quality criteria (%) by Depdikbud (The Ministry of National Education, Republic of Indonesia). The scale was very good range (90-100%), good (80-90%), sufficient (65-80%), weak (55-65 %) and very weak (0-55%) [1]. The effectiveness of media can be seen from the differences in students learning outcomes before and after the use of learning media with N-Gain analysis [3].

**TABLE 1**. The Interpretation N-Gain

| N-gain | Category |
|---|---|
| > 0,7 | High |
| 0,3 ≤ g ≤ 0,7 | Medium |
| g < 0,30 | Low |

## RESULTS AND DISCUSSIONS

### Learning media KONELA

The development of KONELA media was a three-dimensional form of the Aufbau principle that was made by the development of the lights. The media uses a switch that was connected with an LED (Light Emitting Diode) lamp with marbles as electrons. The light was an indicator of the sequence of charging electron configurations according to the Aufbau principle. KONELA media testing was done by inserting marbles into the media to find out the sequence of electron configurations based on the Aufbau principle. For example, if you were going to do an electron configuration on $_{10}$Ne so 10 of them would be inserted into the media so that the students will press the switch, then the light that would turn on was $1s^2\ 2s^2\ 2p^6$. Based on the light sequence, students will understand the sequence of charging electron configurations based on the Aufbau principle. The real form of media and its components can be seen in Fig. 1 below.

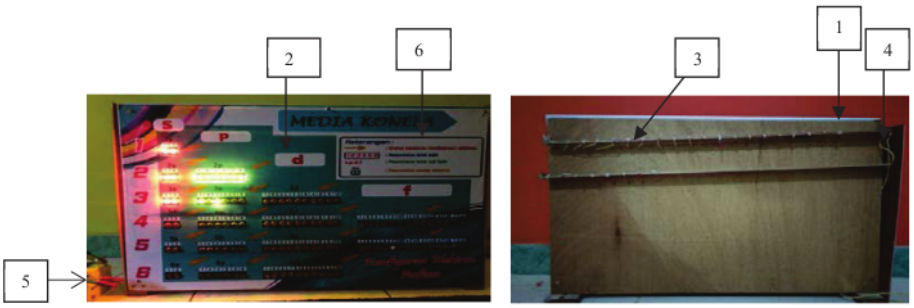



**FIGURE 1.** (a) Media KONELA (front side), and (b) Media KONELA (back side)

Information :

1. The entry point of electrons/marbles
2. LED lights
3. Metal plate
4. Cable
5. Battery and cable clamp
6. Caption

## Analysis The Quality of Media

**TABLE 2.** The eligibility score of the media by validators and learning practitioners

| Aspects | Score by validator | Category | Score by practitioners | Category |
|---|---|---|---|---|
| Eligibility of content | 96.8 | Very good | 96.8 | Very good |
| Eligibility of technic | 91.2 | Very good | 96.6 | Very good |
| Eligibility of presentation | 94 | Very good | 94 | Very good |
| Eligibility of electronics | 97.5 | Very good | 95 | Very good |
| Eligibility of language | 94.05 | Very good | 87.5 | Good |
| Learning aspects | 100 | Very good | 98.4 | Very good |
| Average score (%) | 95.6 | Very good | 94.7 | Very good |

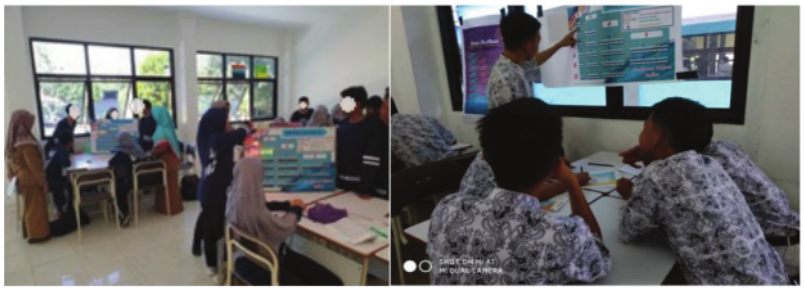
Table 2 shows data on KONELA media feasibility from every aspect. The result from the validator is 96.8% with a very good category for the Eligibility of content. It shows that the media was in accordance with the learning material and has the truth of the concept. Eligibility of technic shows the results of the evaluation was 91.2% with a very good category. It shows that the media was easy to use in the learning process. Eligibility of presentation shows the results were 94% assessment with very good categories show that the design, physical condition, material, color of the lights and the size of the media were very good. Eligibility of electronics shows the results of an assessment was 97.5% with excellent categories including component layout, voltage suitability used and accuracy in the use of component types. Language feasibility shows 94.05% results with a very good category showing the writing and grammar of KONELA's media use was very good and easy to understand. Learning aspects show the results of the assessment was 100%, indicating the KONELA media can clarify the material. The average media rating was 95.6%, it has a meaning that the quality of the media was very well used in learning with electron configuration material. That was in accordance with the 91% assessment results by practitioners (chemistry teachers) with very good categories.

## Effectiveness of Media

**TABLE 3.** Student scores from aspects of the analysis were N-Gain values and student response

| N-Gain | Student response | N-Gain two-dimensional media | Student response |
|---|---|---|---|
| 0.63 | 90.1 | 0.42 | 70.5 |

Table 3 above shows a comparison of the average N-Gain scores and student responses using Konela media (experimental class) and two-dimensional media (control class). The score can be used by measuring the effectiveness of the KONELA media in the learning process. According to Akker [6], the effectiveness of the media was seen from the potential effects in the form of the quality of learning outcomes. N-gain from both classes based on the Hake category [4] was included in the medium category. However, the experimental class and the control class differ in quantity. The experimental class N-Gain mean was higher than the control class N-Gain mean. That was because the KONELA media used in the experimental class makes students more interested in learning by exploring to construct knowledge in charging electron configurations based on the Aufbau principle through direct learning experience. The knowledge obtained through the process of constructing knowledge by each individual will provide deep meaning. Students enter marbles, then pay attention to the lights that were lit and write the sequence of charging electron configurations.



(a) (b)

**FIGURE 2.** (a) learning with KONELA, (b) learning with two-dimensional media

Through experiments with the KONELA media, students can explore to construct their own understanding. Learners try electron configurations with various elements and then conclude how to fill electrons based on the Aufbau principle. KONELA is a three-dimensional learning media that can be used to clarify the concept of electron charging according to the Aufbau principle, the symbols in the form of LED lights that were lit into stimuli or sensory memory information that has meaning in memory so that students better understand the concepts that were ultimately expected to be transferred into storage long-term memory of students, so the use of KONELA media was more meaningful than the two-dimensional Aufbau bridge media used in the control class. This was thought to be one of the reasons for the increase in N-Gain in the experimental class higher than the control class.

Data analysis of the response results of experimental class students had a higher presentation than the control class. The data shows that students interest and motivation were higher if they use KONELA media. The high positive response of students using KONELA media was caused by several things, (1) media can display motion which was a visualization of electron filling sequences, (2) media has symbols in the form of lights so that it becomes stimulation or sensory memory information that has meaning for students, (3) the media actively involve students in the learning process because students can directly use the media and observe the lights so that they can easily determine the sequence of electron configurations based on the Aufbau principle. Which is by using the two-dimensional Aufbau bridge media the percentage of students' responses was lower, that was because (1) the media only emphasizes visual sense perceptions only, (2) students were not actively involved in using media because verbally two-dimensional Aufbau bridge media was limited to just observation.

## CONCLUSIONS

KONELA media development was carried out with excellent quality. The validity of KONELA learning media (Aufbau electron configuration) developed has very good quality with a percentage of 95.1%. (2) The practicality of the KONELA learning media (Aufbau electron configuration) developed has very good quality with a percentage of 90.1%. (3) In terms of increasing mastery of concepts, KONELA media is declared effective in increasing mastery of concepts in the medium category with N-Gain 0.63 in the experimental class and 0.42 in the control class. The use of KONELA media in the experimental class has an average N-gain score higher than the use of two-dimensional Aufbau bridge media in the control class.

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