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The Analysis of Students' Mental Models Using Macromedia Flash-Based Learning Media on Molecular Shapes Lesson

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Abstrak

Profil model mental siswa sangat diperlukan untuk mengetahui keberhasilan dan kesulitan siswa dalam mendeskripsikan representasi sifat-sifat kimia secara makroskopis, submikroskopis dan simbolik. Penelitian ini bertujuan untuk menganalisis profil model mental siswa kelompok eksperimen dan kontrol serta mengetahui pengaruh media pembelajaran berbasis Macromedia Flash terhadap model mental siswa kelas X MIA. Penelitian ini dilaksanakan pada Tahun Pelajaran 2019/2020 di SMA Negeri 1 Pekanbaru pada materi Bentuk Molekul. Jenis penelitian ini adalah Mixed Method yang memadukan penelitian kualitatif dan kuantitatif dengan desain eksplanatori. Sampel yang diambil sebanyak 20 siswa dengan teknik Simple Random Sampling. Instrumen yang digunakan dalam penelitian ini adalah tes diagnostik two-tier dan wawancara untuk memperkuat data yang diperoleh. Hasil penelitian menunjukkan bahwa profil model mental siswa kelompok eksperimen dengan menggunakan media pembelajaran berbasis Macromedia Flash secara keseluruhan memiliki 70% model mental utuh dan 30% model mental alternatif. Siswa kelompok kontrol memiliki 37% model mental utuh dan 63% alternatif. Hasil penelitian juga menunjukkan adanya pengaruh media pembelajaran berbasis Macromedia Flash terhadap model mental siswa. Hasil pengujian hipotesis penggunaan bantuan SPSS menunjukkan sig. (2-tailed) 0,000, artinya Ha diterima dan H0 ditolak.

Abstract

The profile of students' mental model was very needed to know student successes and difficulties in describing the macroscopic, submicroscopic, symbolic representation of the characteristics of chemistry. This research aimed at analyzing the profile of students' mental model of experimental and control groups and knowing the effect of Macromedia Flash-based learning media on students' mental model at the tenth grade of MIA. This research was conducted in the Academic Year of 2019/2020 at State Senior High School 1 Pekanbaru on Molecular Shapes lesson. It was Mixed Method Research integrating qualitative and quantitative researches with explanatory design. There were 20 students as the samples selected using the Simple Random sampling technique. Instruments used in this research were two-tier diagnostic tests and interviews to strengthen the data obtained. The data results showed that the experimental group's profile of students' mental model using Macromedia Flash-based learning media overall had 70% intact mental model and 30% alternative mental model. The control group students had 37% intact and 63% alternative mental models. The research findings also showed an effect of Macromedia Flash-based learning media on students' mental models. The result of hypothesis testing that SPSS was used to help showed sig. (2-tailed) 0.000, it meant that H_a was accepted and H_0 was rejected.

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INTRODUCTION

The chemistry concept is described in three different representations, viz macroscopic representation, submicroscopic representation, and symbolic representation (Andinia *et al*., 2017). The macroscopic level is the level of real representation that can be observed directly, chemical phenomena in experiments, or internal phenomena in everyday life. The submicroscopic level is the real representation level; however, at the particulate level such as describing, explaining and making predictions about chemical properties. Principles to explain it using things like the movement of electrons, molecules, and atoms. The symbolic level is the level of representation to explain what is observed using models or analogies, chemical equations, mathematical equations, graphs, and reaction mechanisms (Armalita, 2014).

Chemistry learning must include all three levels of representation to produce a complete understanding of chemistry. If students can connect levels of representation chemistry, the chemistry learning process will be more meaningful (Becker *et al.,* 2015). Understanding the three levels of representation is frequently termed a chemical, mental model. By the time students can connect all three levels of chemical representation in a concept, students have a complete mental model, whereas when students cannot connect the three levels of chemical representation on a concept. Hence, students have an incomplete mental model (Yoni *et al.*, 2018).

The three levels of chemical representation are interrelated and reflected in students' mental models (Halim *et al.,* 2013). Mental models can be thought of as inner products of learning. This is because mental models can provide information about concepts students or the underlying structure. Knowing students' mental models allows student successes and difficulties to be known (Khodriah, 2016). Mental models can represent ideas in one's mind that describe and describe the phenomenon. To explain a phenomenon, mental models act as a substitute for describing the concept (Yudani *et al.,* 2016).

The level of students' understanding of a concept, especially abstract concepts, can be seen from students' mental models (Mulyani *et al.*, 2015). Model analysis mental can determine students' conceptions of a concept given to the learning process, especially the abstract concept of chemistry. Students' mental model for the teacher is significant for determining the learning strategy suitable in future learning, teaching materials, or structured media for students' understanding of a concept to become a complete unit (Yudani *et al.*, 2016).

But in reality, there is chemistry learning going on so far that students are more likely to understand at the macroscopic level (Handayanti, 2015). This problem also occurs at SMAN 1 Pekanbaru in the molecular form material. The interview results obtained from the chemistry teacher stated that the frequency of learning only focused on the macroscopic level, as for the submicroscopic and symbolic levels getting less appreciation from students. This is due to the inability of students to visualize structures and processes at the submicroscopic and incapable level relate it to other levels of chemical representation (Darmiyanti *et al.*, 2017). This is one of the reasons students' mental models are not intact because of the difficulty of students in understanding the concepts of the three levels of representation that are of character abstract is not perfect. Misunderstanding cognitive concepts and structures in previous lessons can interfere with students' understanding of the concepts in subsequent lessons (Khodriah, 2016).

To understand abstract learning, it is necessary to have media to help solve problems faced in the learning process (Murtiningrum, 2013). Media has a clear function, namely to clarify, facilitate and create interesting material that will be conveyed by the teacher to students so that they can motivate learning and streamline the learning process (Mawarni *et al.,* 2015).

Macromedia flash can be an alternative learning media that is used to solve the problems that have been described previously. Macromedia Flash is a program used to create multimedia animations, interactive and 2D animation (Meitantiwi *et al.*, 2015). Utilization Macromedia flash can also make it easier for students to understand a concept that is abstract because to understand abstract concepts in chemistry, needed higher-order thinking skills (Kurniawati *et al.*, 2021).

For this reason, in this study, an analysis of students' mental models was carried out to find out the extent to which the mental model profile that students have when connecting the three levels of chemical representation, which gets learning by knowing the conceptions of students an abstract concept given to the learning process is also expected will be recognized, so it is expected to reduce the possibility of misconceptions (Handayanti, 2015).

METHODS

The method used in this research is mixed-method Research), which combines qualitative and quantitative research. Mixed methods research is a research approach that combining between qualitative and quantitative research (Kurniawati, 2019). This research focuses on a mental model of high school students in understanding the shape of the molecule, in the future referred to as a mental model. The design of this study uses an Explanatory model Design. This method consists of three processes as follows: (1)

quantitative process, (2) qualitative process, and (3) The data interpretation process is based on the first and second processes (Creswell, 2010). Samples examined in this study are ten students from class X MIA 1 and 10 students from class X MIA 2 SMAN 1 Pekanbaru registered in the 2020/2021 school year. This sampling is based on a simple random sampling technique. Learning Media used in this study designed by Paradila Rulia Pratiwi, S.Pd. Technique data collection used in this study is a test in the form of a diagnostic test with two-tier ten items on the material form molecules. The test contains questions about chemical representations that are useful for seeing the quality of students' mental models. Furthermore, interviews are intended to see the effect of learning media on the model mental students. The stages of data analysis on diagnostic test questions two-tier are: perform the validity test, reliability test, level of difficulty, and distinguishing power of the questions carried out with the help of Anates version 4.05 and homogeneity test and hypothesis testing with using SPSS assistance. The researcher then presented the diagnostic test values two-tier on the molecular shape material by giving the criteria high, medium-low (Yudani *et al.*, 2016).

Analysis of students 'mental models was carried out on each concept in each question grouped based on the students' answers into four categories, namely:

a. Scientifically Correct (SC)
b. Partially Correct (PC)
c. Specific Misconception (SM)
d. No Response (NR)
e. (Sendur, Toprak, & Pekmez, 2010).

RESULTS AND DISCUSSION

The data for recapitulation of the diagnostic test two-tier of the experimental and control class students can be seen in Figure 1 and Figure 2 below. Based on the study results, the overall percentage of students in the experimental class after treatment with learning using learning media Macromedia Flash had a scientifically correct mental model, 26% partially correct mental model and 4% model mental misconceptions specifically. This shows that the mental model profile of students after using learning media Macromedia Flash on 70% molecular form material has dominant scientific mental models or conceptual mental models. In comparison, the remaining 30% of students still have alternative mental models. Whereas in the control class, which during the learning process of molecular form material without using learning media Macromedia Flash, the overall mental model achievement results are scientifically correct by 37%, 54% of the mental model is partially correct, 7% of the mental model has certain misconceptions, and 2% of the model mentally no response. This shows that the mental model profile of students without using learning media Macromedia Flash on the molecular form material 37% have a scientific mental model or a conceptual mental model intact. In comparison, the remaining 63% of students still have an alternative mental model.

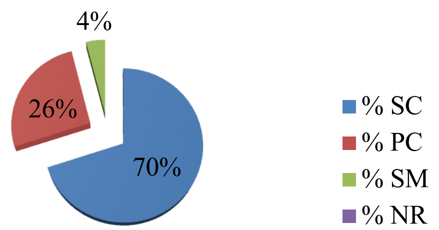

Figure 1. Recapitulation of diagnostic test values for two-tier experimental class students

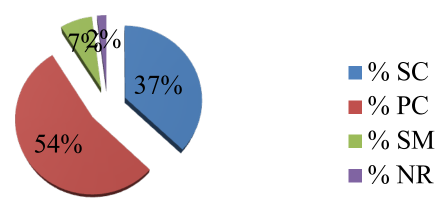

Figure 2. Recapitulation diagnostic test for two-tier control class students' mental model

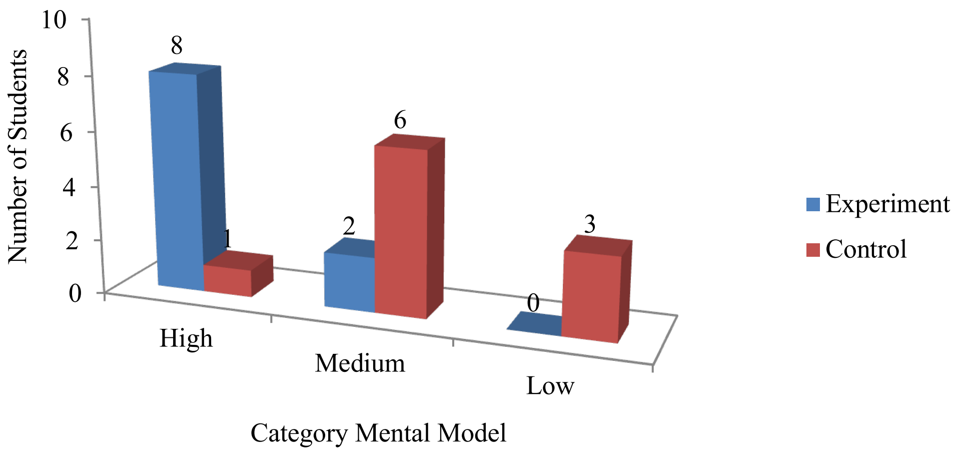

Figure 3. Classification of student mental model level

If viewed from the acquisition of the results of students' mental models between the experimental and control classes, it can be seen that students in the experimental class have a higher percentage of intact conceptual mental models than the control class. This is because students in the experimental class who are given treatment using media Macromedia Flash can see abstract molecular shape objects presented to be interesting to study. Students no longer need to imagine the abstract material. The results of the achievement of each student's mental model score category between the experimental and control classes can be seen in Figure 3.

Based on the data in Figure 3, it can be seen that students in the experimental class obtained the classification criteria for the model level mentally better than the control class. Students in the experimental class are in the high-level category of dominant mental models, and two students are in medium-level mental models. Meanwhile, students in the control class are still dominated by the level of mental models in the medium category. In addition, students in the control class only have one student in the high mental model classification and still have students with a low mental model category.

This study also indicates that students in the experimental class have a more dominant achievement score than students in the control class. The low score achievement category in the control class was due to the weak interconnection of students in linking the three levels of representation to obtain a complete mental model. In contrast, students in the experimental class have been accustomed to learning by linking the three levels of chemical representation using media Macromedia Flash during the learning process. In addition, the largest mental model that students have in the experimental class is dominated by scientific or conceptual mental models, which is 70%. In contrast, the control class is still dominated by alternative mental models, namely 63% consisting of 54% partial mental models (Partially Correct). PC), 7% had misconceptions in certain parts (Specific Misconceptions/ SM), and 2% had no answers (can be seen in Figures 2 and 3). These results indicate that students in the experimental class, after using-based learning media Macromedia Flash have a dominant intact conceptual mental model compared to the alternative mental model, with a ratio of 70%: 30%. Even though it still has an alternative mental model, the comparison of the scores of this mental model has a high achievement category according to the diagnostic test mental model scoring category rules two-tier, because a complete conceptual mental model cannot be obtained 100% intact in a short time. After all, it requires a process. Excavation and trained by applying the chemistry learning process with three levels of representation in an irregular period.

Comparing the whole mental model and the alternative students in the control class is proportional, namely 37%: 63%. This is because alternative mental models still dominate students, namely partially correct (Partially Correct), misconceptions in certain parts (Specific Misconceptions), and no answer/response (No Response/ NR), because based on the results of students' answers in the control class they mostly it is difficult to relate the theory of the number of electron pairs to the shape of the molecule. Students in the control class still understand the three chemistry levels in molecular form material. This is reflected in the inability of students to explain answers at the macroscopic, submicroscopic, or symbolic level. The inability of students to relate when the chemical level causes the students' understanding to be incomplete so that students experience an alternative mental model that is very dominant compared to students in the experimental class.

Students can only obtain a complete mental model when students can relate their knowledge to the three levels of representation because the three levels of representation (symbolic, macroscopic, and submicroscopic) are interrelated, and these three representations have a role in forming students' mental models (Darmiyanti *et al.*, 2017). To determine whether or not the media affected students' mental models, the researchers conducted a t-test with the help of software SPSS version 16.0. Based on the data obtained, it can be seen that sig. (2-tailed) = 0.000, which means 0.000 <0.05. This shows a difference between students who learn using learning media Macromedia Flash and those who learn without using Macromedia Flash. The use of this media is constructive for students in the learning process. Students can see directly the material presented, which is accompanied by pictures related to the material so that it makes students feel clearer and the material presented looks more real. Learning becomes more challenging and motivates students to find out by asking questions to become active and serious in the learning process than students whose learning process does not use media Macromedia Flash. In addition, students do more learning activities, not only verbal communication through the speaking of words by the teacher, but also other activities such as observing pictures and explaining the material in the media.

This result is in line with Gustina's research (2016); she states that the advantages of learning media Macromedia Flash can present material comprehensively and systematically so that it is easier for students to understand and allows students to master better teaching goals. The many advantages of this learning media can have a significant positive effect on student learning outcomes (Gustina *et al.*, 2016). Based on the results of interviews that the researchers conducted with five students who had a conceptual dominant mental model intact, it was found that they were very interested in studying molecular form material with the help of media Macromedia Flash so that the material that tended to be abstract became easier to understand and learning tended not to be monotonous because, In the media, students are presented with pictures related to the material in the form of molecules and their learning simulations, different from the ordinary learning process.

CONCLUSION

Overall, the mental model profile of students in the experimental class is dominated by the conceptual mental model is intact. In contrast, students in the control class are still dominated by alternative mental models. The percentage achievement obtained is 70% mental model intact and 30% alternative mental models for experimental class students and 37% mental models intact, and 63% alternative mental models for control class students. There is an influence of Macromedia flash-based learning media on students' mental models.

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