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Application of POE Based Module in Reaction Rate Material to Improve Students' Critical Thinking Abilities

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Abstract: *The use of teaching materials in schools is one of the supports in the learning process. Modules are teaching materials that students can use in learning. This research aims to 1) Determine the level of validity of the module being developed; 2) Knowing the increase in students' critical thinking abilities taught with the modules developed; 3) Knowing students' responses to the modules being developed. The research method is R&D with the 4D development model. Data collection techniques through BSNP questionnaires, student response questionnaires and N-Gain tests to improve critical thinking. The population was Holy Kids Bersinar Medan High School. Based on material and media expert validators, it shows that 84.7% of material experts, 83.75% of media experts, the modules developed have a validity level of "Very valid". The module was also successful in improving students' thinking abilities through pretest and posttest scores that were carried out and the n-gain was searched for and obtained a score of 0.83% in the "High" category. Student responses to the development of this module received score of 93.05 in the "Very Good" category. Thus, it can be concluded that the use of POE-based chemistry modules has been successful in improving students' critical thinking abilities.*

Keywords: *Module; POE; Reaction Rate; Critical Thinking*

INTRODUCTION

Education is a learning process that aims to optimally develop all potential within students which includes cognitive, affective and psychomotor potential. This needs to be done to improve the quality of education. Teachers play an important role in determining improving the quality of learning and learning outcomes that their students will achieve (Silaban & Panggabean, 2022). Teachers must also have teaching and critical thinking skills according to the subjects taught

in the classroom. Teachers act as moderators or mediators while designing the learning process so that students are active and creative in seeking new knowledge (Sugiharti & Hasibuan, 2017). According to 21st century learning principle, teachers and lecturers act as facilitators in a student-centered learning environment. To get students actively involved in learning activities, teachers and lecturers must be able to develop appropriate learning strategies, models and media (Panggabean et al., 2023).

Chemistry studies the composition, structure, properties, changes in materials and changes in energy. Chemistry was born from the desire of chemists to get answers to what and why the properties of materials exist in nature, each of which would produce facts and theoretical knowledge about matter whose truth could be explained the explanation using mathematical logic (Suswati, 2021). Some aspects of chemistry are visible, which means concrete facts can be made and some are only abstract (invisible), meaning they cannot be proven by mathematical logic so that rationality can be formulated (Sugiharti et al., 2019). Reaction rate material is abstract material and difficult for students to understand. This material discusses factors that influence reaction rates (Sakti et al., 2020). Factors such as concentration, temperature, surface area and catalyst of course the reaction cannot be seen with the naked eye or are abstract. In the reaction rate there are also mathematical calculations and many factors that cause an increase in the reaction rate (Marpaung & Sutiani, 2020).

Based on the results of interviews conducted with chemistry subject teachers at Sma Holy Kids Bersinar Medan, the information they obtained in the learning process at school using modules that support chemistry learning was still limited, general in nature, and supported by textbooks. It was found from the results of interviews that students did not understand the material on reaction rates, which caused the thinking abilities of students at this school to still be relatively low, less than 50% understood the material on reaction rates. Apart from that, schools only use conventional models and do not vary. A learning model that is not varied makes students bored and lazy to think so that students do not train their critical abilities when learning in the classroom.

One of the teaching materials that can be used is a module, which is a program package of teaching materials designed to help independent learning. The use of modules further improves students' critical thinking abilities compared to open materials

that are not modules (Harahap & Bayharti, 2021). POE-based modules can be used for material that is difficult to understand because in this module there are application examples in everyday life. Students can first understand and build knowledge about all existing phenomena and then observe these phenomena themselves independently, in this way students can hone their critical thinking skills also in learning using POE-based modules (Rahman et al., 2016).

According to Nurfiyani et al., (2019) modules with the POE learning model can improve students' understanding of the concept of thinking abilities compared to non-module teaching materials. Modules with the POE learning model are an alternative that can be used by teachers to create a fun and quality learning atmosphere.

LITERATURE REVIEW

Characteristics Module

Each teaching material has characteristics that differentiate one teaching material from another, including modules. A good module should fulfill the following characteristics: self-instructional, self-contained, stand alone, adaptive, and user friendly (Harefa, 2020).

The self-instructional module is expected to provide opportunities for students to learn independently without relying too much on guidance from teachers or other parties. The characteristics of self-instructional modules include several important components, such as clearly formulated learning objectives, arranging material in subsections to facilitate understanding, using examples and illustrations to explain the material, providing practice questions and assignments to measure student understanding, using simple and easy language. understood, as well as a summary of the learning material (Amdayani et al., 2022). Independent modules cover all the material that will be studied from one competency or sub-competency as a whole. The stand-alone module does not require other learning media and can be used

independently. Meanwhile, adaptive modules are adapted to developments in science and technology. A user-friendly module must be easy for students to use and make it easier to understand the module content. Thus, the module must be designed in such a way that students can learn independently effectively and efficiently (Muliaman & Mellyzar, 2020).

Purpose of Making the Module

The aims of compiling or creating modules according to Andi Prastowo (2013) include: The use of modules in learning aims to enable students to learn independently, both independently and with teacher guidance. In this way, the teacher's role will not be too dominant and authoritarian in the learning process. Modules can also be a means to train students' honesty, because they are expected to learn independently and test their own understanding. In addition, modules can also be designed to accommodate various levels of student learning, so that each student can learn according to their own pace and abilities (Dalimunthe et al., 2022).

Predict, Observe, POE's Explanation Based Learning Module

This POE-based module can shape students' cognitive structures for the better because the activity stages in this module provide opportunities for students to learn concretely (Putri et al., 2022)

The results of POE-based module research make chemistry learning effective, can link old concepts with new discoveries so that the learning received by students will be more meaningful, and can eliminate students' misunderstandings and influence students' critical thinking abilities (Hidayat & Andromeda, 2017) POE-based modules are an alternative that can be used by educators to create a fun and high-quality learning atmosphere (Restami et al., 2013).

Critical thinking

Humans cannot have critical thinking skills from birth, but can be trained through learning. Critical thinking skills are a person's skills to think rationally and reflectively. This

thinking must focus on beliefs and decisions that will be made Facione (2013).

METHODS

This research was carried out at Holy Kids Bersinar Medan High School which is located at Jl. Tuberosa Flowers XII No.15 Medan, Medan City Prov. North Sumatra in the odd semester of the 2023/2024 academic year, namely November to December 2023. The population in this study were all students at Holy Kids Bersinar Medan High School, chemistry teachers. The sample in this study were students of class XI Science at Holy Kids Bersinar Medan High School.

Qualitative data analysis techniques were obtained from research results on questionnaires containing BSNP teaching material assessment standards. The modules that have been developed will be standardized or analyzed using descriptive percentage analysis. The instrument in this research used the BSNP questionnaire. Validation is carried out with media and material experts and validation of questions is carried out by evaluation experts.

The research design used in this research is Research and Development or better known as Research and Development (R&D). The development model in this research uses a 4D model, namely: defining, designing, developing and disseminating.

Data analysis in this research uses a material and media expert analysis validation test, namely using a Likert scale with answer criteria shown in table 1 below.

Table 1. Answer Criteria with a Likert Scale

No	Answer	Score
1	Very valid	4
2	Valid	3
3	Less valid	2
4	Invalid	1

and the table to determine the validity criteria shown in table 2 below.

Table 2. Answer Criteria with a Likert Scale

Average	Category
76%-100%	Very Valid
56%-75%	Valid
40%-54%	Less valid
0%-39%	Invalid

The analysis was carried out to see student responses to the modules developed using criteria, shown in table 3 below.

Table 3. Criteria for Calculating Student Questionnaires

Skor Interval	Category
0-39%	Very not good
40-55%	Not good
56-75%	Good
76-100%	Very Good

RESULT AND DISCUSSION

Before conducting the research, validation was carried out first with material experts and media experts.

Material Validation

Material expert validator evaluates content feasibility aspects, presentation feasibility aspects, POE-based module suitability aspects. The following are the results of POE-based module evaluation on reaction rate material in accordance with BSNP validity requirements.

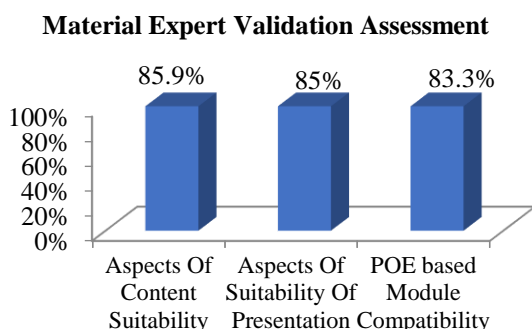


Figure 1. Assessment figure by material experts

Based on the results table of the percentage of material expert validators from making POE-based modules on reaction rate material, the overall average (%) is 84.7% with a very valid category. The average value was obtained using the assessment of material experts so that it was stated that the POE-based chemistry module was suitable for use.

Media Validation

Media expert validators evaluate component presentation aspects, POE component aspects, graphic aspects. The following are the results of the POE-based

module evaluation on reaction rate material in accordance with the BSNP validity requirements.

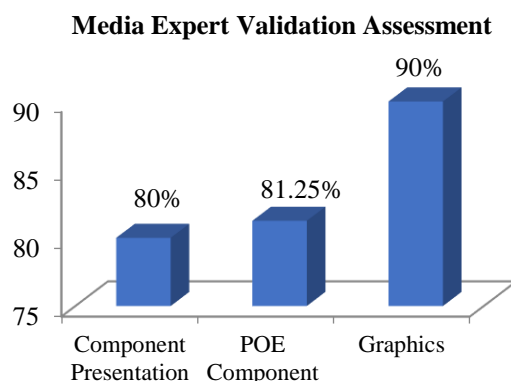


Figure 2. Media Expert Validation Evaluate

Based on the results table of the percentage of media expert validators from making POE-based modules on reaction rate material based on BSNP, the overall average (%) is 83.75% with a very valid category. The average value obtained was based on the assessment of media experts so that it was stated that the POE-based chemistry module was suitable for use.

Based on the research results of Murtihapsari et al., (2022), looking at various aspects such as summarizing, classifying, explaining, giving examples, interpreting and concluding. All aspects studied have increased with an average value of 0.62, so it is estimated that students' POE model modules will experience an increase in understanding of concepts that have been validated by experts.

N-GainTest

From the calculation data using Microsoft Excel, the n-gain score value was sought to see how students' thinking abilities improved after taking the pretest and posttest in learning using POE-based modules.

Calculations for increasing critical thinking skills can be obtained from the average gain value of all sample class students multiplied by 100%. Based on sample class gain calculations using Microsoft Excel. The average gain for class XI Science is summarized in the table 4.

Table 4. N-Gain results data

Class	Criteria	N-Gain Average	% Gain	Category
XI IPA	%g<30= Low 30<%g< 70=Curr ently %g>70= High	0.83	83%	High and Effective

Based on the table above, it can be seen that the % gain for class So it can be concluded that the use of chemistry module teaching materials based on POE (*Predict, Observe, Explain*) in reaction rate material can improve students' critical thinking abilities. Research conducted by Cahyati (2019) used test instruments and observation sheets. The results obtained with the critical thinking sub-indicator are N-Gain 0.7921. So, it is concluded that the POE model-based module can improve students' critical thinking skills.

Student Response

Results of student responses Student responses to the implementation of learning with POE-based chemistry modules on reaction rates were known through giving questionnaires to students after the last meeting.

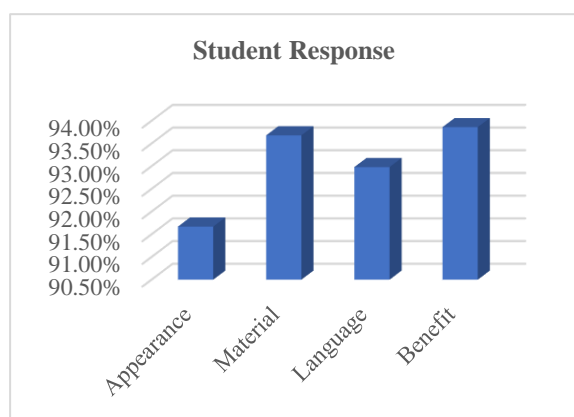


Figure 3. Student response questionnaire figure

Based on the results table on the percentage of student responses, it was found that the overall average (%) was 93.05% with Very Good criteria. From the results obtained, the module developed can make students interested in learning and this module is a supporting learning resource for

students. Students responded well to the development of this POE module, with a final average a score of 81 is considered very good (80-100 is the range for a very good rating). According to for students, this product is interesting, innovative, practical (easy to use), and effective (more time saving) for use in small scale chemistry experiment. Students hope to develop it POE skills are even better in other chemistry experiments, and this practical module can disseminated at the secondary school (Harta et al., 2020)

CONCLUSION

The results of this research state that module validation is measured through validation by material and media experts. The material expert validation of the POE-based chemistry module on the topic of reaction rate reached 84.7% and was classified as "very valid", while the media expert validation of the similar chemistry module reached 83.75% with an assessment of "very valid" as well. Then, the increase in students' critical thinking skills was measured using n-gain analysis which showed a result of 0.83%, in the "high" category, based on a comparison of the Pretest and Posttest. Student responses to the module via questionnaire showed the "very good" category with a positive percentage reaching 93.05%. The impact of developing modules on science and technology is to produce science teaching materials that can be accessed by students anytime and anywhere, so that students learn independently to practice their thinking skills and modules as infrastructure that teachers can use to facilitate learning that is useful for increasing knowledge in the future.

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