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Validity of Discovery Learning-Based E-module with Video Demonstration on Reaction Rate Material for High School Student

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Abstract: This research aims to determine the validity of the discovery learning-based E-module with a video demonstration on reaction rate material for high school students. The type of research carried out is development research with the Plomp development model. This research involved three chemistry lecturers of the Faculty of Mathematics and Natural Sciences of Universitas Negeri Padang and two high school chemistry teachers. The advice of expert reviews and students was used as the basis for module evaluation by researchers using a validity questionnaire—the Aiken's V formula processed module validity tests from chemistry lecturers and chemistry teachers. According to the findings, the developed e-module has an Aiken V value of 0.88 and is classified as valid.

Keywords: Discovery learning; E-module; Reaction rate module; Validity; Video demonstration.

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Introduction

Discovery Learning is a learning model that encourages students to discover concept by themselves (Jasri & Masunah, 2019) (Faradillah, et al., 2021). The teacher's presentation of lesson materials is not final, but students are allowed to find their own through a problem-solving approach technique (Indonesia Ministry of Education and Culture, 2013) (Supardi, 2013). This discovery learning model can be applied to various chemical materials, one of which is reaction rate (Supardi, 2013; Nurcahyo, et al., 2018; Rizki, et al., 2021). In odd semesters in Indonesia, one of the main subjects studied by class XI SMA/MA students is reaction rate (Indonesia Ministry of Education and Culture, 2008). Students in this subject must memorize and calculate the information obtained and understand concepts closely related to the material and can be obtained through practical/experimental experiences (Hendryanto, et al., 2013).

The findings of observations made at SMAN 7 Padang, SMAN 1 Lubuk Alung, and SMAN 2 Sawahlunto by giving each student a questionnaire, obtained information in each school of 67.7, 75, and 75 percent of students respond on the material reaction rate, respectively, were difficult to understand. The three schools also constrained the practicum's implementation by arranging the schedule; even during the Covid-19 pandemic, the three schools did not carry out practicum on the reaction rate material. After distributing one questionnaire to each school's teachers, it was discovered that the teachers' reaction rate material used modules, textbooks, student worksheets, and PowerPoint. The display of the teacher's teaching materials used in learning the material for the reaction rate of 65, 60, and 70 percent of students stated that it was less attractive.

One solution to this problem is to replace the learning media (Indina & Maryanti, 2021; Dewi & Harini, 2021). An e-module is learning media that have been systematically designed and packaged in an

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electronic format (Fausih & Danang, 2015; Budiman, 2017; Malik, 2018). E-module also have its function in online learning as it is now, in the Covid-19 pandemic.

The developed e-module designed using Microsoft Word applications, Google Forms, and Flipbook PDF Professional (Mukhtar, et al., 2020). The practicum demonstration video in the e-module edited using the Kinemaster application. The e-module is then uploaded via the platform, allowing students to access the e-module. It also has a conversation, and discussion feature, which can help students understand the material and communicate with the teacher more easily (Pujasari & Ruslan, 2021).

Based on the above description and the benefits of the e-module created, the researcher will conduct a study titled "Validity of Discovery Learning-Based E-module with Video Demonstration on Reaction Rate Material for High School Students."

Method

The type of research conducted was education design research (EDR) (Van der Akker, 2010; Weatherhead, 2020; Tessmer, 1997). This type of research is a research method used to develop or validate products used in education and learning (Tessmer, 1997; Sugiyono, 2011). This research aimed to create a teaching material using an e-module with reaction rate based on discovery learning, complete with a video demonstration. The video demonstration developed will help in the data collection stage in discovery learning. Distribution was done online via the link. Tjeerd Plomp created the model that was used in the development of Plomp (Plomp, 2007). The Plomp development model comprises three stages: preliminary research, concept formation (prototyping), and assessment (Plomp, 2007). In this study, we will discuss the validity of the resulting product.

Preliminary Research Phase

The preliminary research phase follows five steps: needs analysis, literature review, curriculum analysis, concept analysis, and student analysis (Sulistyani, 2019). Needs analysis is carried out by collecting data through chemistry teacher interviews and filling out questionnaires by students via google form regarding the chemistry learning process that has been implemented. The literature review was carried out to find solutions to problems that have been formulated in the needs analysis (Hardeli, et al., 2022). Curriculum analysis is carried out by establishing competency achievement indicators and learning objectives from essential competencies. Concept analysis will produce concept maps that provide information on the relationship between concepts according to essential competencies. Student analysis was carried out to obtain information on the characteristics of students in the intellectual (cognitive) and learning style aspects (Sitorus, 2012).

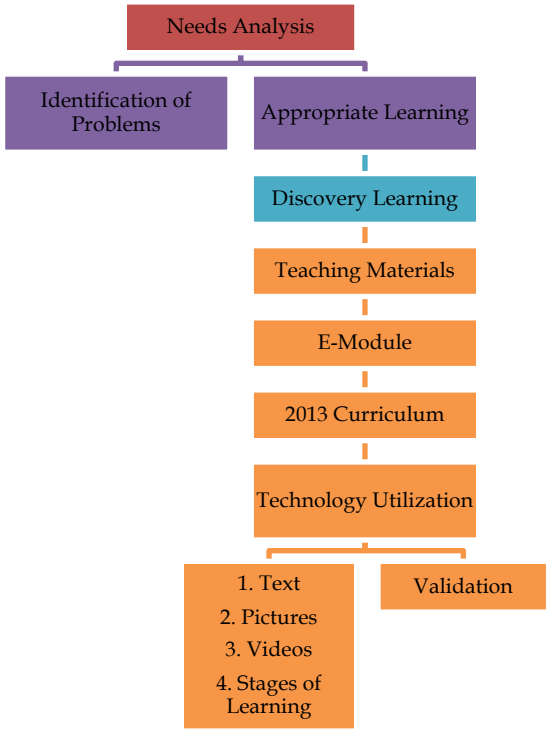

Figure 1. The resulting conceptual framework

Prototyping Phase

The prototype formation stage is a design or design stage carried out in stages and iteratively (Plomp, 2007). At this stage, a formative evaluation is carried out for the results of each prototype stage. Things done at the stage of forming the prototype can be described as follows. The first stage of prototyping was to make the reaction rate e-module format based on discovery learning assisted by, accompanied by a demonstration video based on Basic Competence, which was revealed to be an indicator of competency achievement and learning objectives were made. At the prototype stage II, a formative evaluation is presented in the form of self-evaluation of the prototype product I. The evaluation is carried out using a checklist system for the components contained in the instrument. Then revisions were made to meet the components that were still lacking in the instrument. Revisions were made to improve product quality. At the Prototype III stage, a formative evaluation is carried out in the form of an expert review to obtain the level of validity of the developed e-module. In this expert assessment stage, an assessment of the product developed is carried out. Using a validation sheet, three chemistry lecturers from FMIPA UNP and two chemistry teachers assessed the product. Content validation and construct validation are used for validation. Conformity to the stimulus, questions, and answers to questions are all examples of content

validation. Meanwhile, construct validation includes construction components, language, materials and criteria for the preparation of e-modules. The evaluation results obtained were analyzed so that the validity value of the e-module developed was obtained.

Analysis Technique

The analysis technique is based on categorical judgment using Aiken's V taken from (Retnawati, 2016). Validators are given questions to provide an assessment of each question through a validation sheet. The validation sheet will contain a questionnaire, and the final section will allow the validator to determine the results of the assessment that has been given. The validator's assessment of each statement is analyzed using Aiken's V formula.

Result And Discussion

The result of the research was a reaction rate e-module based on discovery learning for class XI SMA/MA. The e-module was then validated for chemistry lecturers and teachers. This study employs the Plomp development model, consisting of several stages, with the following results.

Preliminary Research

1) Needs Analysis

The needs analysis results obtained at this stage are based on the demands of the 2013 curriculum, where learning is student-centered and independent learning. Furthermore, students are expected to be technologically savvy. Taking a survey with three chemistry teachers. According to the interview findings, the teacher's reaction rate material included modules, textbooks, student worksheets, and PowerPoint.

The context analysis that has been completed includes a curriculum and syllabus analysis. The 2013 curriculum analyzes the syllabus in the form of basic competencies, translated into indicators of competency achievement. This reaction rate material's learning objectives are to dig information from various learning sources, conduct simple investigations, and process information using discovery learning models in expressing opinions, responding to questions, making suggestions and criticisms, and explaining collision theory, the effect of concentration, surface area, temperature, and catalysts on reaction rates based on collision theory, determining reaction rate equations, reaction orders, and reaction rate constants based on experimental data.

2) Study *of* literature

A literature review is an activity that involves locating sources and references related to the research process. Books, journals, and other internet sources can be used as sources and references. The Indonesia Ministry of Education and Culture (2017) was the primary source for developing e-modules and guidelines for preparing e-modules. Hosnan's book (2014) focuses primarily on the discovery learning model. The information for the reaction rate is taken from Raymond Chang, Syukri, Silberberg, and Sudarmo's chemistry book.

3) Conceptual Framework Development

The conceptual framework development stage is when the concepts required before designing the product are identified, detailed, and drafted.

Prototype Stage

1) Prototype 1

Prototype 1 produced a discovery learning-based e-module with components, including cover, instructions for use, learning competencies, concept maps, activity sheets, and evaluations (Wati & Efi, 2021). The results of prototype 1 design are explained as follows.

a) Cover E-module

The cover design of the acid and base e-module based on guided discovery learning consists of several parts such as the title of the module, the target user, the author's name, the supervisor, the author's agency, and supporting pictures. The e-module title provides information to users about the material discussed with a specific learning model. The author's name, supervisor's name, and author's agency serve as the identity of the compiler of the e-module being developed, while the supporting image serves as an attraction to students so that they are interested in using the e-module and is a brief description of the material contained in the e-module. The e-module cover design is shown in Figure 2.

b) Preface, Table of Contents, List of Pictures

c) Competence to be Achieved

The presentation of core competencies and basic competencies were used to determine the minimum competencies that students must achieve in learning the reaction rate so that indicators of competency achievement (GPA) and appropriate learning objectives can be determined.

d) Concept Map

The concept map was obtained from developing a conceptual framework based on the concept analysis table on the reaction rate material.

e) Activity Sheet

Student activity sheets consist of material that students must master following predetermined competency indicators. The activity sheets contained in

the e-module are compiled with discovery learning syntax, which includes (a) stimulation, (b) problem statements, (c) data collection, (d) data processing, (e) verification, (f) generalization. The stimulation stage is a stage for students where students are asked to observe with reading, listening, and viewing activities (without or with tools) to later understand what has been given by the teacher. The data collection stage is the stage for students to explore and collect information in various ways and sources. The activities carried out at this stage are processing data and information found at the data collection stage. At this stage, students are asked to answer questions that guide students in understanding the concept. The activities carried out at this stage are proof of the hypotheses that students in the previous stage have formulated. Students are asked to examine and compare the hypotheses put forward previously with the correct answers after carrying out the data collection and data processing stages so that a concept is obtained from the material being studied. The generalization stage (conclusion) is a stage for students to write material conclusions obtained based on observations during the learning process following learning objectives.

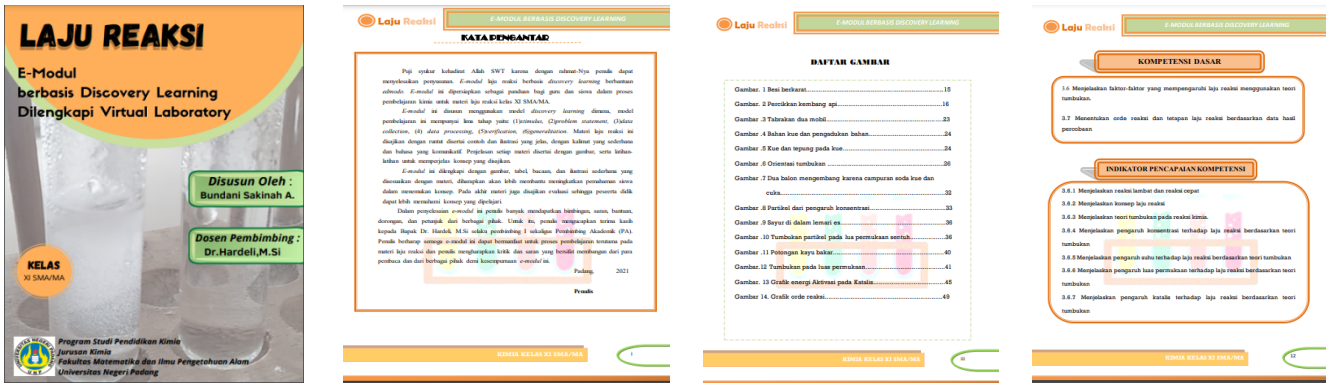

Figure 2. Components of e-modules that have been developed

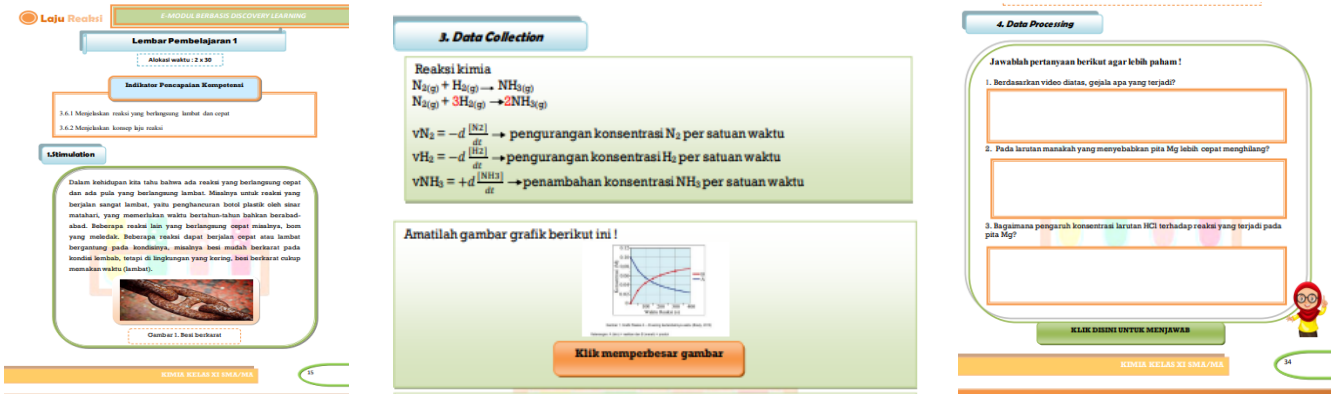

Figure 3. Activity Sheet components of e-modules that have been developed

f) Worksheet

The activities carried out by students on the worksheets are working on the questions contained in the e-module. These questions are in the form of practice questions that are useful for strengthening the concepts that students in the previous learning process have found.

g) Evaluation Sheet

The activities carried out on the evaluation sheet are students working on objective questions that have included all indicators of competency achievement. The evaluation sheet consists of 30 questions and has five answer choices: A, B, C, D, and E.

h) Bibliography

The bibliography is a list of sources used as references in the development of e-modules.

Prototype II

This stage involves formative evaluation in the form of self-evaluation of prototype I. Based on the self-evaluation results, it was found that prototype I needed revisions to parts or components of the e-module that should exist in the resulting prototype I.

Prototype III

1) Expert Review

The resulting prototype II was validated by seven validators, subject experts, and media experts. The

validity tests carried out consisted of three types, namely content validation, construct validity, and media validity. The instrument for collecting data for the validity test is in the form of a validation questionnaire. The validity test includes four components: the content component, the construct component, the linguistic component, and the graphic component. These components can be described as follows:

a) Content Component Assessment

The results of the data analysis of the ISIS component assessment carried out by the validator, namely from the lecturers and teachers, are shown in table 1. Based on the table obtained from the validity of the e-module based on discovery learning, the average content feasibility was 0.88 with a valid category.

b) Construct Component Assessment

The results of the data analysis by the validator can be seen in Table 2. Based on the validation table of the components of the discovery learning-based e-module construct components, the average construct component was 0.89 with a valid category.

c) Linguistic Component Assessment

Table 3 shows the results of the data analysis on the validator's assessment of the linguistic component. Based on the table, the average for the linguistic component of the e-module based on discovery *learning was 0.89.*

d) Graphic component

Table 4 shows the results of the data analysis on the validator's assessment of the graphic component. Based on table 4, the average for the graphic component of the discovery learning-based e-module was 0.88.

Table 1. Results of Content Components

Rated aspect	score	*V*	Category
Competency achievement indicators following Basic Competencies (KD) 3.6 and 3.7	15	0.93	valid
Contents of e-module according to KD 3.6 and 3.7	15	0.93	valid
Formulation of learning objectives following indicators of competency achievement	13	0.82	valid
The material presented in the e-module follows the indicators of competency achievement	14	0.87	valid
The pictures and videos used in the e-module follow the reaction rate subject	14	0.87	valid
The images and videos used in the e-module are scientifically correct	14	0.87	Valid
The stimulation provided can direct students to find concepts	14	0.87	Valid
The questions given in data processing, exercises and evaluations are related to the subject	15	0.93	Valid
The contents of the e-module can add insight to students' knowledge of the reaction rate subject	14	0.87	Valid
Average of Validity		0.89	Valid

Table 2. Results of construct components

Rated aspect	score	*V*	Category
e-module made according to the learning indicator for the reaction rate material	13	0.82	valid
e-modules that are made according to the learning objectives for the reaction rate material	14	0.87	Valid
The questions presented have directed students to achieve indicators of competency achievement for the reaction rate material	15	0.93	Valid
The questions presented in the e-module can direct students to think critically	14	0.87	Valid
The contents are systematic, starting from the title, core competencies, essential competencies, achievement indicators, learning objectives, learning activities, exercises and evaluations	15	0.93	Valid
The presentation of e-modules is based on discovery learning steps, namely: a) stimulation b) problem statements c) data collection, d) data processing, e) verification, f) generalization	15	0.93	Valid
Average of Validity		0,89	Valid

Table 3. Results of Language Components

Rated aspect	score	*V*	Category
Readability of text, images and videos contained in the e-module	15	0.93	Valid
The language used in the e-module is already communicative	14	0.87	Valid
The language used in the e-module is unambiguous/multiple meaning	14	0.87	Valid
The language used in the e-module is a good and correct language according to Indonesian spelling rules	14	0.87	Valid
Consistent in using symbols/symbols contained in e-modules	14	0.87	Valid
Effective and efficient use of language (clear and concise)	15	0.93	Valid
Average of Validity		0.89	Valid

Table 4. Results of Graphical Components

Rated aspect	score	*V*	Category
The typeface used in the e-module is appropriate and attractive	13	0.82	Valid
The font size used in the e-module is appropriate and attractive	14	0.87	Valid
The layout or display on the cover and between the parts in the e-module is interesting	13	0.82	Valid
The images presented can be observed clearly	15	0.93	valid
The animation presented can be observed clearly	14	0.87	valid
The demonstration video presented can be seen clearly	15	0.93	valid
The overall reaction rate e-module design is attractive	15	0.93	valid
Average of Validity		0.89	Valid

Table 5. The Results of the Data Processing of the Construct Validity Assessment Can Briefly Be Seen in the Table.

Rated aspect	*V*	Validity Category
Content components	0.88	valid
serving component	0.89	valid
linguistic component	0.89	valid
Components of Gravity	0.88	valid
average	0.88	valid

Table 6. Improvement Suggestions from Reviewers

Media Expert
- Improve the appearance of the cover to make it more interesting and in accordance with the material discussed. Based on pictures. the cover of the e-module at the beginning was less attractive, because the image displayed was less clear, blurred, and the background color of the e-module was highlighted. After the revision, the image displayed on the cover relates to the application of the reaction rate in everyday life, and the HD quality image makes it clearer, and the orange color as the background color is more visible.
- Select the appropriate button for a larger video view. Based on the image, the button selected at the beginning is smaller and the color is too light, and the size is smaller. After being revised, look for the video button that is not too bright in color, and is bigger in size
- Change the e-module background. The background is white at the beginning and a colored test tube watermark is given to make it more attractive. However, e-modules or teaching materials are more suitable if they are made more colorful. After the revision, the background color was changed and the watermark was removed
- Added manual book for e-module. Previously, the designed e-module did not include a manual book. The manual book functions so that students can understand how to use the e-module, and the features contained in the application that contains this e-module
- Subject Expert
- Improve the first Competency Achievement Indicator in basic competence 3.6. indicators of competency achievement at the beginning show the supporting GPA, not including the key GPA. Because the GPA is the key that can be achieved by students, through direct reduction from the related basic competence. The initial GPA is not directly related to basic competence.
- Delete sentences in the data collection on Lesson Two that are less appropriate. Prior to the revision of the sentence in the data collection stage, it answered the given stimulation. This is not true, because it is not the answer information from stimulation that is loaded
- Improve the image on the data collection of learning sheet 2 about collision theory. Before the revision of the displayed image, the size was small, unclear or blurry, and in English. The teaching materials developed are in Indonesian, so all content in the e-module must be in Indonesian
- Fixed the collision orientation image of the NOCl + Cl compound. Before the revision of the image the Cl ion did not match the actual one, the color of the Cl ion based on the source was greenish yellow. Adjust the shape and color of the ion based on the actual one

Following the revision of the E-module, the validator validates the next stage. This revision aims to improve the e-module based on the validator's suggestions. The validator's suggestions and inputs were used as guidelines in revising the discovery learning-based chemical equilibrium e-module created

The validity test data for the discovery learning-based e-module on reaction rate material was obtained from an assessment instrument in a validation questionnaire. The validity assessment provided by the validator was analyzed using the Aikens'V formula. Validators in this study performed the content and material validity test, so the value used as a reference was 0.88. Thus, an item is declared valid if the obtained Aikens'V value equals or exceeds 0.88 (Lewis, 1985).

The content of the e-module is related to the assessment of the construct validity aspect of the content component of the reaction rate e-module based on discovery learning. According to the validation results in table 1, the average Aikens'V value is 0.88, equal to the

valid category. This content component contains the ideas presented on the subject matter. The content presented can then provide students with additional insight.

The arrangement of the e-module influences the assessment of the construct validity aspect of the reaction rate component of the e-module presentation based on discovery learning. According to the validation results in table 2, the average Aikens'V value is 0.89, equal to the valid category. Based on the Aikens'V value, it is clear that the discovery learning-based reaction rate e-module that was developed meets the demands of Basic Competence, specifically basic competence 3.6 and basic competence 3.7 in the 2013 curriculum syllabus for Essential basic competence. According to (Purwanto, 2006), the content component aspects include the suitability of the material in the e-module with core competencies, basic competencies, learning objectives to be achieved, and material provided following students' abilities.

The use of the author's language in explaining the reaction rate material in the e-module is related to the assessment of the linguistic component aspects. It demonstrates that the discovery learning-based reaction rate e-module that was developed used good, simple, and clear Indonesian so that e-module users could easily understand it. According to (Indonesia Ministry of Education and Culture. 2017), a good e-module should use simple, easy-to-understand language and express general terms to be user-friendly. Based on table 3, the results of the validator's assessment for the linguistic component yielded an average value of 0.89 with a valid category.

The graphic component aspects of the e-module are evaluated concerning the overall appearance or design of the e-module, such as the layout, logo, symbol, and illustration, and the proportions presented must be appropriate and appealing. Based on table 4, the results of the validator's assessment for the graphic component yielded an average Aikens'V value of 0.88 with a valid category. It indicates that the appearance or design has been presented appealingly.

Aspects that were evaluated as a whole to test the construct validity of the reaction rate e-module based on discovery learning and equipped with a virtual laboratory, which was developed based on the obtained Aikens'V average value of 0.88 with valid categories for all aspects.

2) One-To-One Evaluation

A one-to-one evaluation test was conducted on three students with different abilities: high, medium, and low. The teacher who teaches them in school divides the students based on her observation, taking into account various aspects. This one to one evaluation test is carried out through filling out questionnaires by students. Based on the analysis, it shows that the prototype II of the e-module produced is good. It is in terms of the composition of the material, practice questions, steps for learning activities, design, and appearance of the e-module that can help students understand the reaction rate material contained in the e-module.

Furthermore, it was determined that the prototype II produced was attractive in terms of cover appearance and color selection, which was considered excellent and able to attract students' interest in learning it. The choice and use of the font in the e-module were pretty straightforward, and the language used was easy to understand. The material presented in the e-module was excellent and easy to understand. Instructions for using e-modules contain several details that make it easier for students to learn from e-modules. The pictures, tables, and videos presented in the e-module were considered capable of helping students understand the learning material.

Conclusion

Based on the research and data processing results, it was concluded that the problem-based reaction rate module that had been developed was declared valid with an average Aiken's V value of 0.88.

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