EduChemia
Jurnal Kimia dan Pendidikan

Vol.9, No.2, 2024, p.219-238
e-ISSN 2502-4787

DEVELOPMENT OF E-MODULES OF REACTION RATE PROBLEM-BASED LEARNING MODEL TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS AND WASAKA CHARACTER

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Received: 12 July 2024. Accepted: 11 October 2024. Published: 30 October 2024

DOI: 10.30870/educhemia.v9i2.27504

Abstract: This study aims to improve critical thinking skills and *Wasaka* characteristics through the development of a problem-based learning-based reaction rate e-module and to assess the validity, practicality, and effectiveness of the e-module. This research uses the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). In the analysis stage, researchers assess the needs of teaching materials, characteristics of students, and learning objectives. The design stage includes material collection, outline preparation, and e-module prototype design. At the development stage, the author conducted e-module development and validation with expert validators. In the implementation stage, the learning application using the e-module was carried out in class XI B SMA Negeri 10 Banjarmasin with as many as 34 students, which involved practicality and effectiveness tests. At this stage, students learn via e-modules that are accessed via their respective cellphones. The evaluation stage is carried out with 2 types, namely, summative evaluation through pretest and posttest and formative evaluation, by evaluating each stage by revising the e-module. The results showed that the e-module was very valid (score of 4.85), very practical (score of 92.75), and effective in improving critical thinking skills (N-Gain of 0.78) and *Wasaka* characteristics (N-Gain of 0.72). The indicators used in the critical thinking ability variable are the FRISCO *(focus, reason, inference, situation, clarity* and *overview)*. In addition, the *Wasaka* character indicators used are responsibility, hard work and resilience. The results of this analysis indicate that the e-module is very valid, very practical, and very effective in applying the reaction rate material to improve critical thinking skills and *Wasaka* characteristics.

Keywords: Critical thinking skills; E-module; Problem-based learning model; Reaction rate

Abstrak: Penelitian ini bertujuan untuk meningkatkan kemampuan berpikir kritis dan karakter *Wasaka* melalui pengembangan e-modul laju reaksi berbasis Problem Based Learning, serta menilai kevalidan, kepraktisan, dan keefektifan e-modul tersebut. Penelitian ini menggunakan model ADDIE (Analysis, Design, Development, Implementation,

Evaluation). Pada tahap analisis, peneliti menilai kebutuhan bahan ajar, karakteristik peserta didik, dan tujuan pembelajaran. Tahap desain mencakup pengumpulan bahan, penyusunan kerangka, dan desain prototipe e-modul. Pada tahap development, penulis melakukukan pengembangan e-modul dan melakuan validasi kepada validator ahli. Tahap Implementasi dilakukan pengaplikasian pembelajaran menggunakan e-modul di kelas XI B SMA Negeri 10 Banjarmasin sebanyak 34 peserta didik, yang melibatkan uji kepraktisan dan efektivitas. Pada tahap ini peserta didik melakukan pembelajaran menggunakan e-modul yang diakses menggunakan handphone masing-masing. Tahap Evaluasi dilakukan dengan 2 macam yaitu evaluasi sumatif yaitu melalui pretest dan posttest dan evaluasi formatif dengan melakukan evaluasi pada setiap tahapan dengan melakukan revisi pada e-modul. Hasil penelitian menunjukkan bahwa e-modul sangat valid (skor 4,85), sangat praktis (skor 92,75), dan efektif meningkatkan kemampuan berpikir kritis (N-Gain 0,78) serta karakter *Wasaka* (N-Gain 0,72). Adapun indikator yang digunakan pada variabel kemampuan berpikir kritis adalah (FRISCO) *focus, reason, inference, situation, clarity* dan *overview.* Serta indikator Karakter *wasaka* yang digunakan adalah tanggung jawab, kerja keras dan Tangguh. Hasil analisis ini menunjukkan bahwa e-modul sangat valid, sangat praktis, dan sangat efektif diaplikasikan pada materi laju reaksi untuk meningkatkan kemampuan berpikir kritis dan karakter *Wasaka*.

Kata kunci: kemampuan berpikir kritis; e-modul; problem-based learning model; laju reaksi

INTRODUCTION

Education is a tool or link for maximizing a person's abilities through learning. Using technology and thinking critically are essential skills for self-development in the modern era (Reni Nurhayati et al., 2023). The aim is to improve skills, foster good morals, and create a quality generation of nations for the intellectual progress of the country (Giawa et al., 2020).

One of the essential aspects of life that needs to be learned and improved is the ability to think critically. The ability to think critically helps address complex problems in the future. Therefore, students must possess this skill (Aufa et al., 2021). Critical thinking is a disciplined process that is intellectually active and skilled in conceptualizing, applying, analyzing, synthesizing, and/or evaluating information collected from or generated by observation, experience, reflection, reasoning, or communication as a benchmark for taking action (Nursidin et al., 2022). Critical thinking involves the active use of the mind, which includes the ability to consider, analyze, and evaluate information. The learning process to think critically involves mental activities such as focusing, categorizing information, selecting the relevant information, and assessing truth or validity (Puspita et al., 2021). However, when choosing a learning model, teachers often do not strengthen these abilities. Many students struggle to develop critical thinking skills

(Muntari et al., 2021; Susanto, 2021). One of the subjects in which critical thinking skills are very important is chemistry.

Chemistry learning involves structure, properties, and accompanying energy changes (Tangio et al., 2023). According to Chang (2005), theoretical concepts, calculations, and formulas are included in the characteristics of chemical materials. This causes chemistry to be considered tedious and difficult for many students. This results in low learning outcomes and creates a negative view of students toward learning chemistry (Hidayatussani et al., 2020).

Rusman & Awang (2023), stated that learning chemistry is unique because the material has features that must be remembered and complicated calculations. This hinders learners from absorbing the lesson, ultimately impacting many learners who are not interested in understanding and mastering basic concepts about chemical materials. The reaction rate is one type of chemical material used.

The Ministry of Education and Culture includes reaction rates in class XI SMA/MA-equivalent chemistry learning materials. Activation energy theory, collision theory, and mathematical equations have difficulty visualizing submaterials (Yuliana et al., 2023a). Azzilani Tahta Zilli Arsyka & Tutik Sri Wahyuni (2021), reported that students have difficulty understanding the concentration of reactants in the reaction rate law, which has the same rank as the coefficient of the equivalent reaction equation, and their understanding of how catalysts work. To overcome the problems of these students, an effective and efficient learning approach is needed, as is the cultivation of wasaka characters, to eliminate laziness and increase the sense of hard work in learning and learning models that can improve students' critical thinking skills.

In the initial observations in the field at SMA Negeri 10 Banjarmasin, the students were constrained in their understanding of the reaction rate material, which was supported by the learning outcomes of students, who are usually low. The problem-based learning model can help overcome these problems by encouraging students to use creative approaches to solve problems (Ayunda et al., 2023). Problem-based learning with constructivist learning principles encourages the application of prior knowledge, collaborative learning, and active engagement (Seibert, 2021). In addition, the problem-based learning model can also encourage

communication and critical thinking skills (van der Vleuten & Schuwirth, 2019). It can also encourage the ability to work together in groups and discover and evaluate learning (Zhang et al., 2022).

This model is expected to improve students' ability to think critically. It can also be implemented to support students in improving Wasaka characters because Wasaka characters have a fighting spirit to learn so that they can be used in problem-based chemistry learning. Wasaka's character comes from South Kalimantan motto, "Made of steel from the base to the top," which means working hard without stopping (Agustina et al., 2021). Toughness, hard work, responsibility, and diligence can be measured (Shofina & Annisa, 2023a). Learning that is integrated with culture and the environment can provide more meaningful learning (Kusumah et al., 2020; Ramsay-Jordan, 2020).

A problem-based approach and teaching materials can improve Wasaka's critical thinking skills and character. Thus, it will improve learning and provide variety (Khotimah Harahap & Desviana Siregar, 2020; Nissa & Renoningtyas, 2021). Using e-modules is helpful for supporting learning so that students are not bored.

E-modules are digitally assembled tools that teachers can use to help students learn more effectively. (Sholeh et al., 2023) stated that e-modules can effectively increase students' desire and motivation to learn, as well as their activeness and enthusiasm. (Permana et al., 2021) mentioned that e-modules were developed to enable learners to adjust to their abilities. The development of the reaction rate E-module with the problem-based learning model can improve critical thinking skills and can be juxtaposed with wasaka characteristics. This wasaka character must be instilled in the learning process so that students are familiar with the character of their own region. According to the explanation above, research is necessary to develop an e-module of the reaction rate of the problem-based learning model to improve the critical thinking ability and Wasaka's characteristics.

METHOD

The type of research used is development research (Research & Development). The development model used in this development is the ADDIE development model. This model was chosen because it is more complete and more rational than other models based on product development procedures

(Yuliana et al., 2023b). The ADDIE model consists of the stages of analysis (Analyze), planning (Design), development (Development), implementation (Implementation), and evaluation (Evaluation). where evaluation is carried out to improve the product in each phase ((Maulana & Junianto, 2022; Rayanto, 2020)

In this study, a problem-based learning model reaction rate e-module was developed and used as a guide in the learning process. Figure 1 shows how the development research was conducted. An important requirement that an instrument can be used for data collection tools must have been declared valid and reliable (Arikunto, 2014). Analysis of the validity of the critical thinking test instrument was carried out through consideration and assessment of an assessment team consisting of 3 lecturers from FKIP ULM Chemical Education, 1 media expert, namely, a lecturer from Educational Technology FKIP ULM, and 1 chemistry teacher from SMA Negeri 10 Banjarmasin. The validity of the test instrument was calculated via Aiken's V statistical formula (Table 1). In this study, reliability was measured using Microsoft Excel 2019 by referring to the Cronbach Alpha formula. The reliability of a variable is high if it has a reliability test value > 0.60 (Widoyoko, 2018) (Table 2). For the validity analysis of the e-modules and nontest instruments, refer to the Table 3.

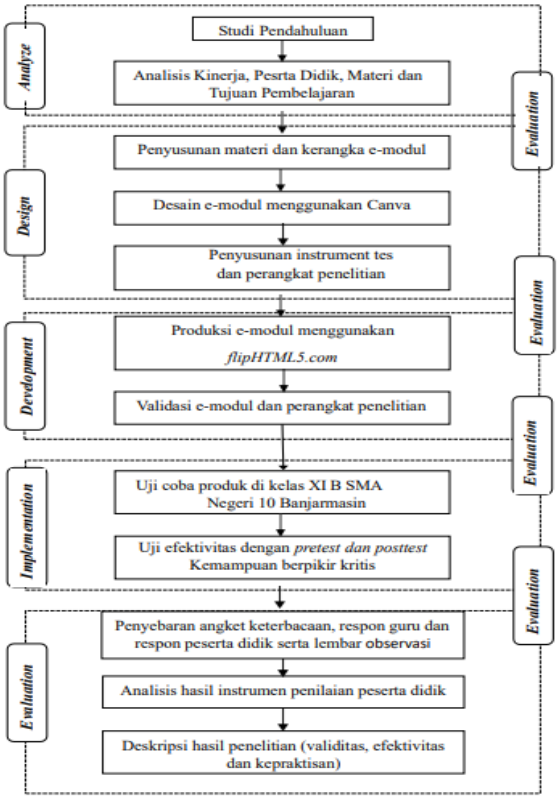

Figure 1. Prosedur Penelitian ADDIE

Table 1. Validity based on Aiken's V Scale

No.	Statistik Aiken's V	Kategori
1.	$V \leq 0,4$	Kurang
2.	$0,4 < V \leq 0,8$	Sedang
3.	$0,8 < V$	Valid

Table 2. Criteria for the Reliability of Test Instruments

Value	Category
0,81-1,00	Ver y high degree of reliability
0,61-0,80	High degree of reliability
0,41-0,60	Fair degree of reliability
0,21-0,40	Low degree of reliability
≤ 0,20	Very low degree of reliability

Table 3. Validation Criteria and Description

No.	Category	Description
1.	$4{,}25 < V \leq 5{,}00$	Very Valid
2.	$3{,}50 < V \leq 4{,}25$	Valid
3.	$2{,}75 < V \leq 3{,}50$	Moderately Valid
4	$1{,}75 < V \leq 2{,}75$	Less Valid

(Azwar, 2021); (Syahmani et al., 2021)

Furthermore, the analysis of the practicality of the e-module involves data from the readability questionnaire, the student response questionnaire and the teacher response questionnaire, as well as the observation sheet concerning the teacher's ability to use the e-module and the implementation of learning (Table 4). Analysis of the effectiveness of e-modules was performed based on data on critical thinking skills with test instruments. The effectiveness test was carried out with a pretest and posttest with several questions on the indicators to be achieved. The criteria for assessing the critical thinking skills of students in the learning reaction rate material can be seen in the Table 5.

To measure the level of improvement in the critical thinking skills test, further analysis was carried out using N-Gain to determine the effectiveness of the use of e-modules (Table 6). The N-Gain score can be subsequently interpreted into the N-Gain effectiveness interpretation category, as in Table 7. The results for the Wasaka characters of the students were related to the attitudes of the students by 3 observers, as shown in Table 8.

Table 4. Practicality Criteria And Description

No.	Score	Description
1.	$4{,}25 < P \leq 5{,}00$	Verry practical
2.	$3{,}50 < P \leq 4{,}25$	Practical
3.	$2{,}75 < P \leq 3{,}50$	Quite practical
4	$1{,}75 < P \leq 2{,}50$	Less practical

(Syahmani et al., 2022).

Table 5. Categories of Critical Thinking Ability

Critical Thinking Ability Score	Decription
76-100	High
60-75	Medium
0–59	Low

(Meryastiti et al., 2022).

Table 6. N-Gain Score Criteria

No.	Nilai n-gain score (g)	Classification
1.	$\langle g \rangle \geq 0{,}70$	High
2.	$0{,}30 \leq \langle g \rangle < 0{,}70$	Medium
3.	$\langle g \rangle < 0{,}30$	Low

(R. R. Hake, 1998)

Table 7. N-Gain Effectiveness Interpretation Categories

Score	Interpretation
>76	Effective
56-75	Moderately Effective
40-55	Less Effective
<40	Not Effective

(R. Hake, 1999).

Table 8. Categories of Achievements in *Wasaka* Character

No.	Average score	Category
1.	$X > 3{,}4$	Very good
2.	$2{,}8 \leqq X \leqq 3{,}4$	Good
3.	$2{,}2 \leqq X \leqq 2{,}8$	Fair
4.	$1{,}6 \leqq X \leqq 2{,}2$	Less
5.	$X \leqq 1{,}6$	Very less

(Shofina & Annisa, 2023).

RESULTS AND DISCUSSION

Research on the development of reaction rate e-modules was conducted at

SMA Negeri 10 Banjarmasin Class XI B with 34 students.

Analysis of the Results

This analysis stage is the underlying stage or the initial stage before carrying out the next stage; this is because, at this stage, data collection is carried out, which is presented as material for making products that include facts and a series of needs in chemistry learning at SMA Negeri 10 Banjarmasin. There are several steps in this stage, namely, initial needs analysis and analysis of students and materials through interviews. The results at this stage are shown in Table 9.

The results of this analysis stage show that it is necessary to develop a reaction rate e-module that uses students' gadgets to provide variations in learning and give a pleasant impression when learning; the learning process that implements the problem-based learning model can also improve critical thinking skills in identifying a problem and can improve students' *Wasaka* character.

Table 9. Results of the Analysis stage

No.	Quetion	Percentage	
		Yes	No
	Teacher		
1.	Have you ever used learning media in the form of e-modules that can be accessed through a link?	-	100%
2	Have you ever applied the Problem Based Learning model on reaction rate material?	100%	-
3	Have you ever linked the *wasaka* character to the learning process?	-	100%
4	In your opinion, is it necessary to develop an e-module on reaction rate using the Problem Based Learning model to improve critical thinking skills and *wasaka* character?	100%	-
	Students		
1	Have you ever used learning media in the form of e-modules that can be accessed through a link?	-	100%
2	Are you interested in using e-modules on reaction rate material with the Problem Based Learning model?	100%	-

Design Results

For the results of the previous analysis, the researcher collected materials, then compiled the module in draft form and compiled the tools and instruments needed for research, which were used to assist in the process of collecting and recapitulating quantitative data during the study. Design can be interpreted as a step in planning a learning program (Pribadi, 2021). At this stage, it produces a problem-based learning model reaction rate e-module framework to improve critical thinking skills and *Wasaka* characters that are ready to be developed and research tools consisting of teaching modules, readability questionnaires, teacher and

student response questionnaires, learning implementation observation sheets, teacher ability observation sheets using e-modules, and *Wasaka* character observation sheets that are ready to use.

Development Results

At this stage, researchers develop e-modules via the website flipHTML5.com. In this stage, the input of images, videos and features that make up the e-module is carried out. In addition, at the development stage, an e-module validation test was carried out on the validator to test the feasibility of using the developed e-module. The results of this stage are e-modules that are ready to be tested and research instruments that are suitable for use. This stage consists of two steps, namely, expert assessment and development trials. At the development stage, the following was implemented:

Validity Test of e-modules

Assessments made by material, media, and language experts to assess development products or called validators. E-modules that are ready are validated by a team of experts to assess the products developed and the feasibility of proceeding to the next stage, namely, the implementation stage (Sugiyono, 2022). The validation team consisted of 3 chemistry education lecturers, 1 chemistry teacher and 1 educational technology lecturer. Several aspects are assessed in the validation of this e-module, such as aspects of presentation, language, content and media feasibility. The combination of validators includes 3 lecturers. The results of the e-module validation test are as in Table 10.

According to the results of the validation test, the e-module was declared valid for use, with a validation score of 4.85 and a very valid category. The e-module is declared valid because it has fulfilled all components and materials to measure learning activities. This is in line with and supported by research that has obtained an average validity test result of 4.6 with a very valid category (Syahmani et al., 2022). In addition, it is also supported by research conducted by (Permana et al., 2021) & (Nia et al., 2022), which states that problem-based learning e-modules are valid for use with very high validity criteria. There are suggestions from validators to improve fonts that are not suitable. This is in line with the research of (Lestari et al., 2022), who reported that the selection of font and font size is one of the important factors for conveying material in e-modules.

Table 10 Validity Test Results

Aspect	Validator					Score	Description
	I	II	III	IV	V		
Isi	4,67	5,00	4,50	5,00	4,92	4,82	Very valid
Penyajian	4,93	5,00	4,73	5,00	4,93	4,91	Very valid
Bahasa	4,71	5,00	4,64	5,00	4,86	4,84	Very valid
Media	4,88	5,00	4,38	5,00	4,88	4,83	Very valid

Practicality Test

This stage is to determine the ease of use of the e-modules made. This practicality test is applied to students, teachers and observers through questionnaires, which are classified as follows: (1) readability questionnaire; (2) teacher response questionnaire; (3) participant response questionnaire; (4) observation sheet of the teacher's ability to use the e-module; and (5) observation sheet of the implementation of the learning. The purpose of the readability test is to analyze the readability level of the module by identifying errors in the module, identifying words that are difficult to understand, and identifying students' reactions to the module when reading it (Dick & Carey, 2009).

The readability test also aims to measure the ability of students to follow the material provided in the e-module and the clarity of the e-module content. This is in line with the research of (Syahmani et al., 2021), who reported that the assessment of the readability of teaching materials is based on several factors, such as the number of clear and not blurry images found to clarify the content of the material. The readability test result is 4.67. According to (Nurul Apsari & Novika Lestari, 2023) and (Fasaenjori et al., 2023), readability testing is needed to strengthen the results in product development. The result of the students' responses was 4.69. The teacher response score was 4.60. The observation result of the teacher's ability to use the e-module is 4.67. The result of the observation of the implementation of learning is 4.65. The average result of the practicality test is 4.66 or, in percentage form, 92.75, with a very practical category. These results are also in line with the research of (Situmorang et al., 2020), who stated that the problem-based learning e-module model is very practical in that it can provide digital learning experiences to students.

Other research by (Musaad & Suparman, 2023) has shown that e-modules based on problem-based learning can spur students' critical thinking skills in the 21st century, which can be seen from the average response of students in a very practical category.

Implementation Results

In this procedure, e-modules and research tools that have gone through the evaluation stage from the previous stage are applied to the implementation stage, namely, using e-modules in chemistry learning. Before and after learning takes place, researchers conduct a critical thinking skills test by distributing six questions to students who are compared with the improvement. In addition, researchers distributed student response questionnaires to determine the practicality of the e-modules developed. The results of this stage are in the form of pretest and posttest data as well as student response data and observations of *wasaka* characters, which are then processed into research results to measure the effectiveness of the developed e-modules.

Results of the Critical Thinking Ability of Learners

Learning begins with a pretest test using the reaction rate e-module. A total of 34 students in the low category < 60 at the time of the pretest and increased in the posttest, as many as 31 in the high category, one medium student, and two low students are the results of the learning test of the knowledge domain of students with the lowest and highest pretest scores of 11.00 and 49.50, with an average score of 27.50. The lowest and highest posttest scores were 71.50 and 93.50, respectively, with an average score of 83.47. This indicates an increase, according to the average results of the students.

The indicators used in this critical thinking ability refer to (Ennis, 2011), namely, the FRISCO indicator (focus, reason, inference, situation, clarity, and overview). Indicators of questions and the effectiveness of e-modules increase students' critical thinking skills, as presented in Table 11.

Table 11. Critical Thinking Ability Based on Aspects

Aspects	Item Numbers	Pre	Post
Focus	1	38.24	94.12
Reason	2	33.33	89.22
Inference	3	34.31	88.24
Situation	6	25.49	86.27
Clarity	5	27.45	87.25
Overview	4	20.59	83.33

Each aspect of critical thinking skills among students has increased. This increase is due to the treatment carried out in the study. namely, the use of e-modules of reaction rate problem-based learning models that involve students directly in the learning process. E-modules with problem-based learning models can maximize chemistry teaching by presenting problems in a context with surrounding life, formulate problems, identify existing problems, and find

solutions to the problems presented (Lembayung et al., 2023). Integrating learning with various models can make it enjoyable for students, which is beneficial for their critical thinking skills. This is related to the chemistry material mentioned by Suswati (2021), that chemistry learning is abstract and concrete, so it requires concrete examples and scientific methods with a series of scientific processes to obtain scientific concepts. laws. rules and principles.

The data obtained are then processed into data with N-gain. Then. The N-gain value obtained is interpreted in the interpretation of effectiveness. The frequency of interpretation of the effectiveness of the e-module developed with 23 learners is effective, eight learners are quite effective, and three learners are less effective. Three learners were declared less effective because the increase in critical thinking skills scores tended to be low. Because at the time of the pretest. The three learners had critical thinking skill scores in the low category, so although they increased, they were still in the low category. This difference was not considered significant because the distance of improvement from the pretest and posttest tended to be small, so it showed low effectiveness. This was also the case for 8 learners whose gap in critical thinking skills scores between the pretest and posttest tended to be small, so the resulting N-gain percentage was in the moderate category.

Based on the data. The N-Gain value was 0.77 with high criteria. Therefore, the reaction rate e-module contributes well to improving students' learning outcomes, as indicated by participants' learning outcomes. These results are supported by research by Dewi et al. (2023),, who reported that e-modules are effectively used to improve students' critical thinking skills, with an N-Gain of 0.72. This e-module is effectively used to improve students' critical thinking skills. This finding is in line with the research of Mahmudah et al. (2022), who reported that 61.12% of students experienced increased critical thinking skills. With problem-based e-modules. It can significantly improve critical thinking skills. Anesa (2021), based on the results of their experiment, stated that the problem-based learning e-module model that uses a research method in the form of a quasi-experiment effectively improves students' critical thinking skills.

Wasaka Character Assessment Results

The observers assessed *Wasaka* characters before and after the use of e-modules for two meetings. *Wasaka*

characters that are trained are aspects of hard work. resilience. and responsibility. The results of the *Wasaka* character assessment before the use of the e-module. Twenty-four students were in the sufficient category, while 14 were declared good. After the use of e-modules increased, as many as 28 students were in the good category, 6 people were in the good category.

The results of calculating the *Wasaka* character value of students per aspect are presented in Table 12. Table 12 shows an increase before and after using the reaction rate e-module, with an average N-gain value of 0.72. The hard work aspect has the lowest n-gain value. This is because the hard work aspect is difficult to train in the *Wasaka* character. Before the problem-based learning model, reaction rate module was applied. Students were not accustomed to being actively involved during learning. This is reinforced by Hastuti et al. (2020), who explain that if students are unfamiliar with learning. Thus, learning objectives, including character development, will be difficult to achieve.

Table 12. *Wasaka* Character Assessment Based on Aspects

Aspects	Before	After	N-gain	Des.
Hard Work	2.60	3.59	0.71	High
Tough	2.63	3.59	0.70	High
Responsibility	2.62	3.65	0.75	High
Average			**0.72**	**High**

Based on the data on the resilient aspect. Before the application of the e-module, a score of 2.60 was obtained, and after the e-module was used, the reaction rate of the problem-based learning model was 3.59 in the very good category. These results show that students develop tough characters during learning. The importance of developing resilient character during learning forms an attitude that is not desperate to achieve the expected goals (Murfiah et al., 2022).

The third indicator observed was responsibility. This indicator has the highest average score. This is because in doing the task. Students are trained to make decisions and solve problems in groups until they complete the task. Identifying problems and using problem-solving skills when deciding social and academic problems is an attitude of responsible decision-making (Virginanti et al., 2019). The increase in the score on the responsibility aspect is inseparable from the use of the e-module reaction rate of the problem-based learning model, where students are asked to be responsible for what they say. At the same time, the teacher only acts as a facilitator during the learning process (Yuliani et al., 2022).

The improvement in all aspects was due to the use of e-modules with a

problem-based learning model. This is because e-modules have problem-based learning syntax. students are instilled with these *wasaka* characters (Anissa et al., 2020). So that overall. All the indicators of *Wasaka*'s character indicate that the development of e-modules is effective, with an increase in the very good category. This research can help students instill and practice *Wasaka*'s character because students can always practice working hard and being resilient and responsible in learning (Sari et al., 2022).

Evaluation Results

Evaluation is a step taken to assess the quality of product development that has been developed (Pribadi, 2021). The evaluation stage is an action taken in each of the previous stages, meaning that at each stage of development, the researcher evaluates, and at the development stage, the researcher makes improvements to the e-module according to comments and suggestions from the validator. In addition, evaluation is also carried out to finish research at all stages to improve the development of e-modules so that they are ready for dissemination.

CONCLUSION

The e-module reaction rate problem-based learning model to improve critical thinking skills and *wasaka* character in students is declared very valid, with a validity score of 4.85 both in terms of design aspects, material and language and media, all of which are in the very valid category. This e-module also meets the very practical category with a practicality score of 92.75, which is assessed from several components, namely, the readability questionnaire, student response questionnaire, teacher response questionnaire and observation sheet for implementation and teacher ability to manage the class. The e-module reaction rate problem-based learning model to improve critical thinking skills was developed to meet the effective category, with an N-Gain critical thinking score of 0.78 and a score of 0.72. The suggestion for further research is to produce e-modules that can be accessed offline or do not require internet access.

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