



RESEARCH ARTICLE

NEEDS ANALYSIS OF PHYSICS E-MODULE BASED ON PROBLEM BASED LEARNING MODEL INTEGRATED 21ST CENTURY LEARNING

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Manuscript Info

Manuscript History

Received: 05 July 2023

Final Accepted: 09 August 2023

Published: September 2023

Key words:-

E-module, Problem Based Learning, 21st Century Learning

Abstract

In the 21st century, science and technology are developing very rapidly. We as humans live in this century so that we can participate and follow progress. Learning in the 21st century emphasizes several skills such as creativity, critical thinking, communication and collaboration skills. Therefore, in facing this era, learning must be able to produce students who have various skills to achieve success in life. However, the facts found in the 21st century skills field are still relatively low. The problem based learning model is a learning model that is able to improve students' 21st century abilities. This study aims to identify problems in schools and basic needs as material for consideration in the development of physics e-modules. This research is a preliminary research with the Plomp development model. The results of this preliminary study are (a) printed books are still dominantly used in schools, there are no teaching materials integrated with 21st century learning, the learning system tends to follow conventional methods; (b) The average 21st century skills of students are still at a percentage of 68.86% in the sufficient category; (c) the average results of the analysis of student characteristics are still lacking; (d) The problem based learning model is considered effective for improving students' 21st century skills.

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Introduction:-

In the 21st century, science and technology are developing very rapidly. We as humans live in this century so that we can participate and follow progress. New innovations have been introduced across a number of disciplines to better prepare humanity for the challenges that lie ahead. The same applies to education, where teachers must prepare students for life in the 21st century (Nilyani et al., 2023; Zan et al., 2023). Increasingly advanced technological developments have begun to be applied in learning to increase efficiency. Learning in the 21st century emphasizes several skills such as creativity, critical thinking, cooperation, problem solving skills, communication skills, social skills, and character skills. Therefore, in facing this era, learning must be able to produce students who have various skills to achieve success in life (Yulkifli et al., 2019), students must master 21st century skills in order to play a role in the world of education and be able to work and survive in the future by using the skills they have.

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One of the skills that must be mastered by students in education is Learning and Innovation Skills (learning and innovation skills), also known as the Four Cs, namely critical thinking, communication, collaboration, and creativity (Hasanah & Malik, 2019). 21st century skills have a very important role in the process of learning physics, this is because learning physics does not only focus on mastering facts, concepts, principles, and laws, but also involves other skills, such as the ability to find information, use technology, apply the scientific method, and critical thinking skills (Hudha et al., 2017). Physics is part of the natural sciences which strengthens the ability to think analytically in overcoming various problems related to events around us (Ningrum et al., 2015). Learning Physics is expected to be able to instill and cultivate the habit of thinking and behaving scientifically critically and creatively, so that students can apply this scientific mindset in various situations in their lives (Kallesta, 2017). Thus, they will be better prepared to face complex challenges and problems in an analytical and innovative way.

Based on the explanation above, it can be seen that the importance of 21st century skills for students in learning physics. However, the facts found in the 21st century skills field are still relatively low. Based on this problem, we need a solution to overcome it. The solution chosen in this study is to develop teaching materials in the form of physics E-modules based on problem based learning models integrated with 21st century learning with global warming material. In current technological developments, most students are more interested in teaching materials that utilize other media such as personal computers/laptops, even smartphones compared to teaching materials in the form of printed worksheets (Haryanto et al., 2020). E-Modules can be a means to assist and facilitate teaching and learning activities so that effective interactions will be formed between students and teachers so that they can increase student activities in increasing learning outcomes. The created e-module integrates the problem-based learning model. The problem based learning model is a learning model that is able to improve students' 21st century abilities.

Problem based learning is a student-centered learning model, with learning methods that encourage students in investigations to solve real life problem cases (Fidan & Tuncel, 2019; Gusti & Ratnawulan, 2021). Problem-based learning is considered capable of fostering a creative, collaborative spirit, developing higher-order thinking skills, increasing understanding, increasing independence, facilitating problem solving, and building teamwork (Salamiyah & Kholiq, 2020). The problem based learning model trains higher-order thinking skills, helps students to process existing information and gathers students' knowledge about the social world and its surroundings (Yustina et al., 2022). So that this model is very effective when applied in physics learning to improve the quality of learning and support the improvement of 21st century skills.

Several previous studies have also shown the effectiveness of using teaching materials and integrating problem based learning models in improving students' 21st century skills, this is evidenced by the results of research conducted by (Rahmawati et al., 2017; Nurhasanah et al., 2023; Sri Ulina, 2022) shows that the use of problem-based learning-based teaching materials can improve critical thinking skills. Meanwhile according to Firdayanti et al., 2020, the results of the study show that problem-based learning-based teaching materials on global warming material meet valid qualifications and are suitable for use as learning resources.

However, there are some limitations from previous research. First, researchers only develop E-modules based on problem based learning models only to see one 21st century skill. Second, there has been no development of teaching materials in the form of E-modules based on problem based learning models that are integrated with 21st century learning. Third, there has been no development of teaching materials in the form of E-modules based on integrated problem based learning models of 21st century learning on global warming material. This preliminary research aims to identify problems in schools and basic needs as material for consideration in the development of a physics e-module based on the integrated problem-based learning model of 21st century learning.

Methods:-

The preliminary research of this research is a preliminary research with the Plomp development model. The procedures for the activities carried out in this study are shown in Table 1.

Table 1:- The preliminary research phase of the Plomp development model.

Stages	Research Analysis	Activity Description
Preliminary Research	Analysis of Student Needs and Student Characteristics	Collecting information about students' needs for e-module physics based on problem-based learning

		integrated with 21st century learning and information about student characteristics at SMAN 3 Sungai Penuh and SMAN 2 Kerinci. Gather information on the 21st century skill level of students at SMAN 3 Sungai Full and SMAN 2 Kerinci.
	Analysis of Teacher Interview Results	Gathered information by interviewing 2 class X physics teachers at SMAN 3 Sungai Penuh and SMAN 2 Kerinci. Questions posed to teachers related to teaching materials, learning systems, models and approaches as well as the need for problem based learning physics e-modules integrated with 21st century learning
	Process Standard Analysis	Collect information related to the implementation stage of learning which consists of preliminary activities, core activities and closing activities.

The instruments used to collect data are shown in Table 2.

Table 2:- Data Collection Instruments.

Analysis	Instrument	Reference
Student needs	Questionnaire	Kurniati et al., 2021
Student 21st century skills	Questionnaire	Association, 2012; Festiyed et al., 2022; R. Kelley et al., 2019

The student needs questionnaire consists of 28 statements using the Guttman scale with alternative answers yes (1) and no (0). The students' 21st century skills questionnaire consisted of 33 statements using a Likert scale with five alternative answers, namely strongly agree (5), agree (4), doubt (3), never (2) and never (1). The process standard sheet consists of 29 statements using the Guttman scale with yes (1) and no (0) answer alternatives. Then the final value of the questionnaire is obtained by the formula:

$$\text{Finalscore} = \frac{\text{ScoreAcquisition}}{\text{MaximumScore}} \times 100\%$$

Result and Discussion:-

This research was conducted at the preliminary research stage in high school physics learning with the Plomp development model. The following stages of this research can be seen as follows:

Student Needs Analysis

The needs analysis carried out in this study aims to determine the basic problems needed in product development. At this stage, questionnaires were distributed to students' needs and interviews with physics teachers at SMAN 2 Kerinci and SMAN 3 Sungai Penuh related to the teaching materials used, learning systems, models and approaches, and their impact on students' 21st century skills. Based on the results of the interviews, there are several basic problems encountered in the field, namely: first, the teaching materials used in schools still focus on printed books as a learning resource. Second, teachers already use worksheets or other media such as power points during the learning process, but the media used has not been integrated with 21st century skills. Third, teachers rarely use teaching materials in the form of self-developed e-modules according to the demands of 21st century learning. Fourth, teachers have used models and approaches that are in accordance with the demands of 21st century learning, but have not been optimal. Fifth, the 21st century skills of students in schools are still relatively low.

Based on the results of the student needs questionnaire, data was obtained for the use of learning resources, namely 92% used printed books, and 81% of students stated that handbooks were not enough to be used as learning resources, 83% of students stated that they wanted to try learning using problem based learning e-modules, 95% students stated that they needed teaching materials that could be used to learn material concepts more easily and interestingly such as e-modules.

Based on the results of the analysis of students' needs, solutions to the problems encountered can be provided by developing e-modules for class X high school physics based on problem based learning integrated into 21st century learning. E-modules are considered to be able to increase student learning motivation, improve critical thinking skills and respond positive from students (Laili et al., 2019; Suarsana & Mahayukti, 2013; Ummah et al., 2020). Problem based learning is a model that encourages students to learn cooperatively in groups to find solutions, think critically, think creatively, and involve students directly in the process (Hotimah, 2020; Noer & Gunowibowo, 2018; Prayudha, 2017; Sucipto, 2017; Sudarman, 2007). 21st century learning aims to build individual learning abilities and support the development of students to become lifelong learners, active, independent and able to compete in the present and the future (Havid & Yulkifli, 2022; Hudha et al., 2017).

Analysis of Student Characteristics

Analysis of student characteristics is needed in research to determine the initial characteristics of students as a basis for consideration in developing e-modules. This is because each individual has different characteristics. Analysis of student characteristics is known based on a questionnaire. The questionnaire used consists of aspects of interest, attitude, motivation and learning style. The results of each aspect of student characteristics can be seen in Figure 1.

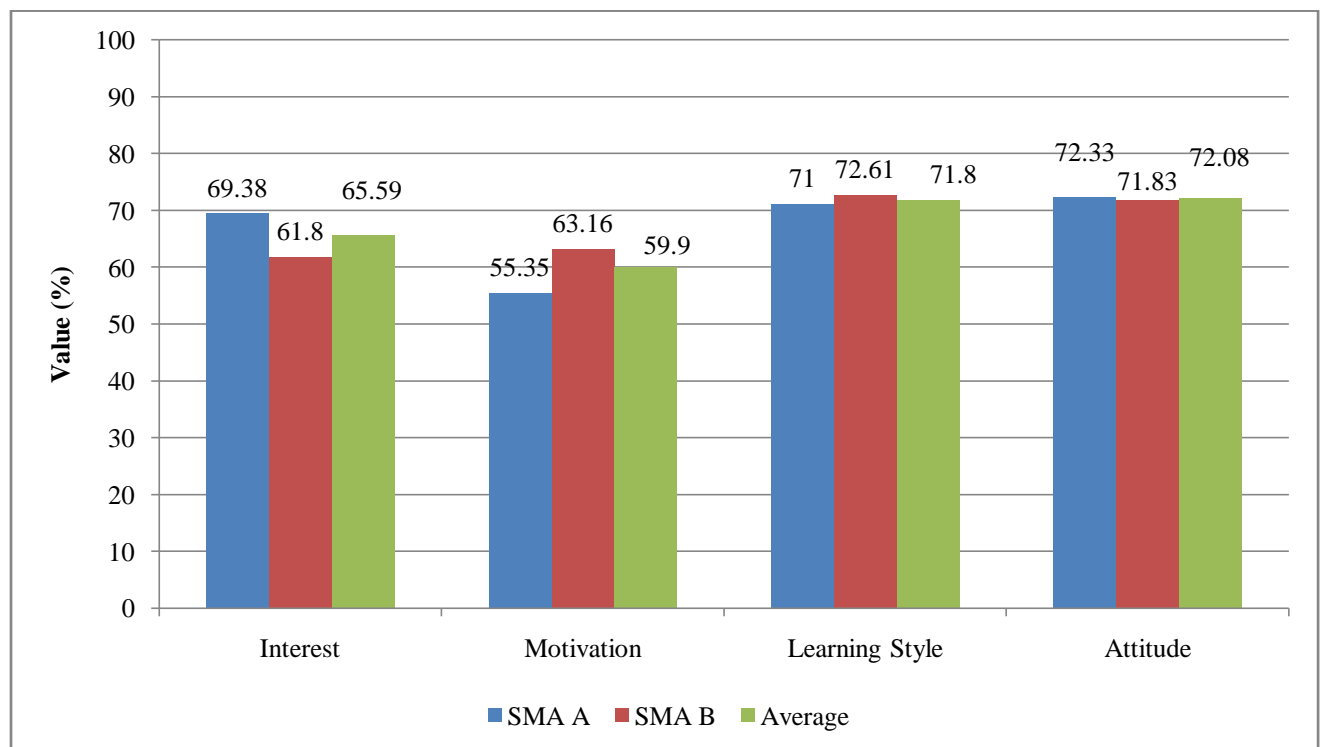


Figure 1:-The results of the analysis of student characteristics.

Based on Figure 1, it is known that the results of the analysis of the characteristics of students who have the highest average score are aspects of attitude with an average percentage of 72.08%. As for the aspect of interest with an average percentage of 65.59% with the sufficient category, the aspect of learning style with an average score of 71.8% with the sufficient category and for the aspect of student learning motivation which is the aspect with the lowest average score of 59.9% in the low category. This must be improved again. In the aspect of student learning styles, in general, they tend to learn using technology-based teaching materials with an average of 76.14%. The solutions that can be given to increase student interest and motivation are by providing technology-based teaching materials and integrating them with problem based learning models and 21st century learning in the learning process

(Aulia et al., 2019; Diarsa, 2021; Fauzan et al., 2017; Fidiana et al., 2012; Gunawan et al., 2018; Hamdalia Herzon et al., 2018; Lintang & Wardani, 2017; Muslim et al., 2015; Nuraini & Kristin, 2017; Nurliastuti et al., 2018; Rerung et al., 2017; Suari, 2018; Wardaini, 2021; Yustianingsih et al., 2017).

Student 21st Century Skills Analysis

Students' 21st century skills can be seen through a questionnaire with 33 statements. The results of the analysis can be seen in Figure 2 below.

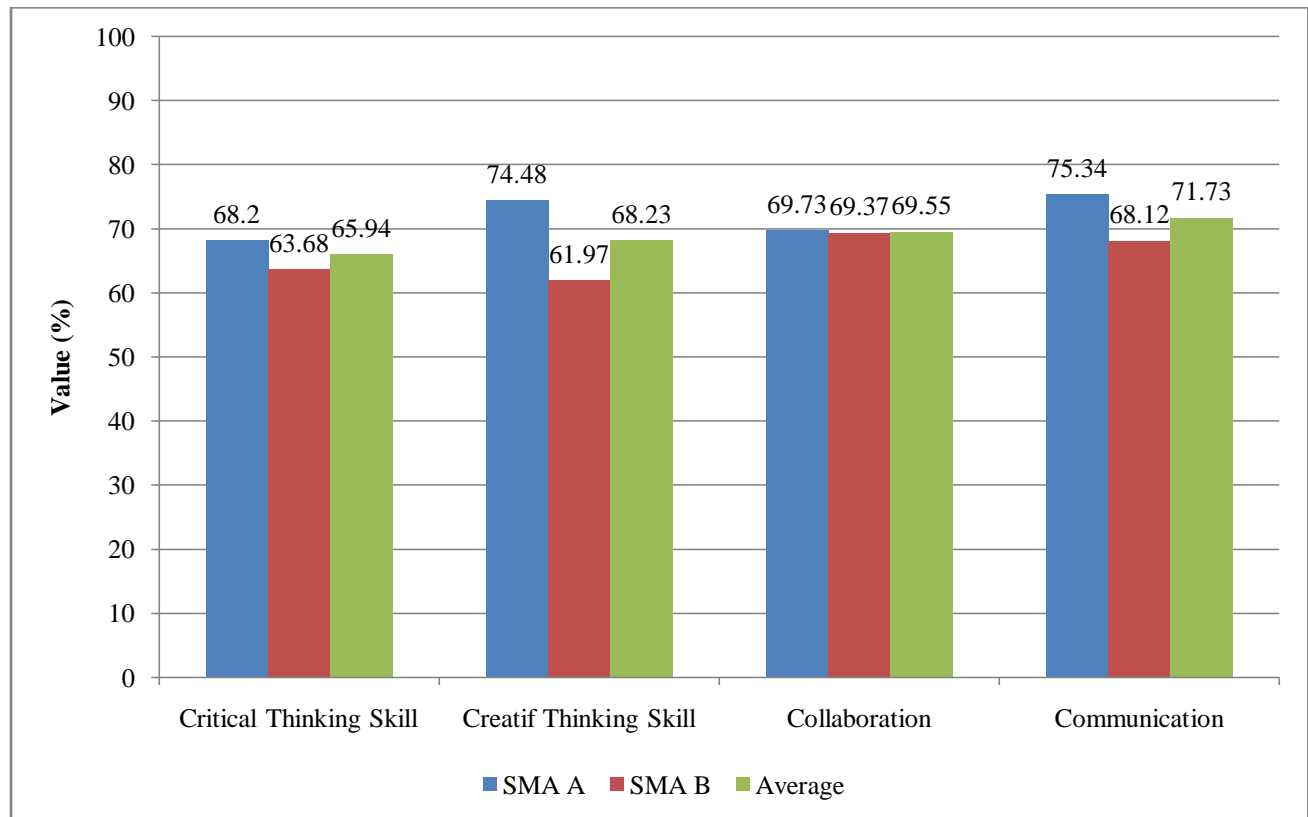


Figure 2:- Results of the analysis of students' 21st century skills.

The 21st century skill that has the highest average score is communication with an average percentage of 71.73% in the sufficient category, while aspects of other skills such as critical thinking skills with an average percentage of 65.94%, creative thinking skills with an average percentage -an average of 68.23%, and collaboration skills with an average percentage of 69.55%. The overall 21st century skills average is 68.86% in the sufficient category. This still needs to be improved because students' skills must be at a superior or high level (Varghese & Musthafa, 2021). To improve 21st century skills, it is necessary to have teaching materials based on learning models that are able to improve 21st century skills.

Process Standard Analysis

Process standard is one aspect that needs to be analyzed in preliminary research. Process standards aim to guide the implementation of effective and efficient learning processes in developing potential, ability, and independence (Peraturan Pemerintah RI, 2022). The standard process consists of planning and implementing learning. The implementation phase consists of preliminary activities, core activities consisting of using models, media, learning resources, and approaches, and closing activities. The results of the process standard analysis can be seen in Figure 3.

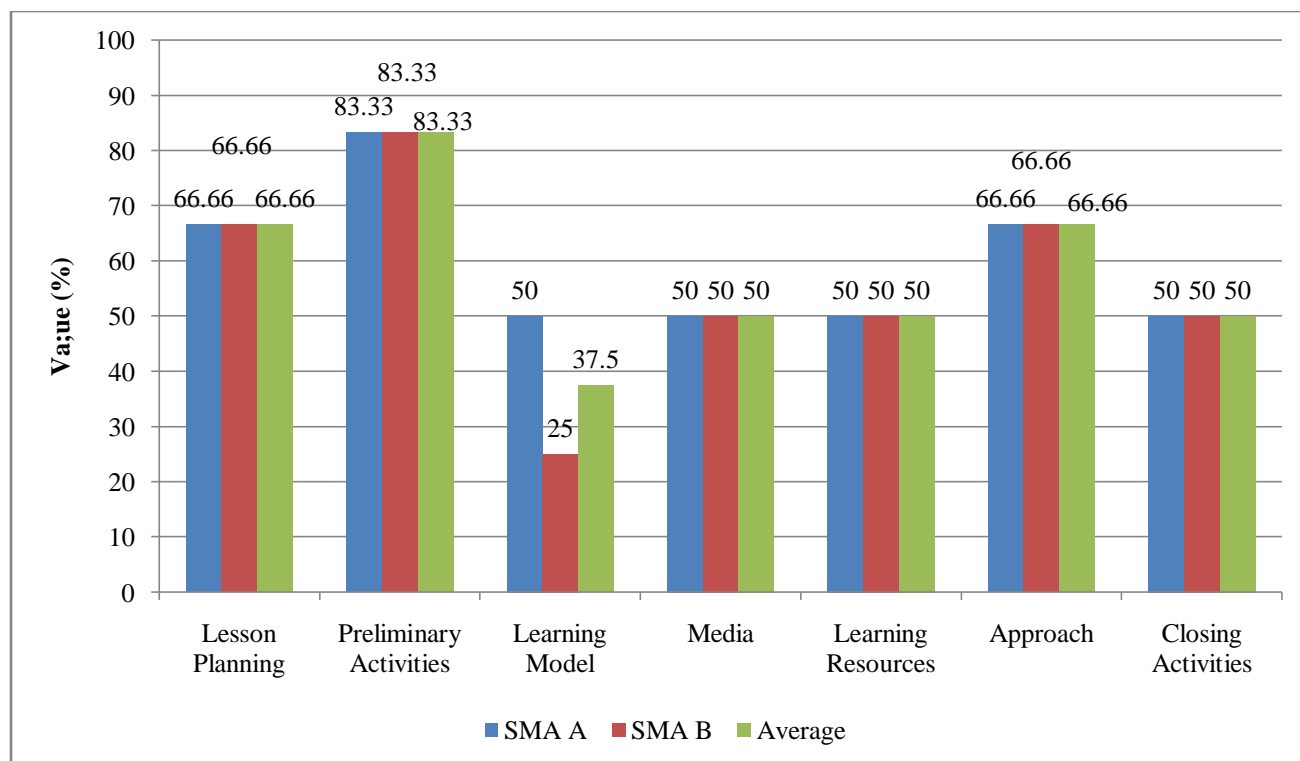


Figure 3:- Process standard analysis results.

Based on Figure 2 it is known that in the standard process aspect the indicator that has the highest average value is the preliminary activity indicator with an average value of 83.33%, which is a good criterion. The indicator with the lowest score is the application of learning models with an average of 37.5% in the very less category and learning resources with an average value of 50% which are included in the less category. Based on the standard process analysis, it is known that the application of learning models and the use of learning resources in schools is not optimal, so improvements need to be made. The selection of learning models can be seen as a systematic teaching guide for educators. The teaching model functions to shape the curriculum, design teaching materials, guide teaching, and create teaching situations (Asrizal et al., 2018). Learning resources are also important in supporting the learning process. Using educational teaching materials can encourage and facilitate student learning (Asrizal & Festiyed, 2020). Based on this description, learning resources can be integrated into learning models that can facilitate teachers and students in learning and make learning centered on students.

Theory and Concept Analysis

The effectiveness of problem based learning models. The problem based learning model has many positive impacts on learning outcomes, both on attitudes, motivation and interest in student learning (Diarsa, 2021; Fauzan et al., 2017; Nuraini & Kristin, 2017; Nurliastuti et al., 2018; Rahmat, 2018; Rerung et al., 2017; Suari, 2018; Wardaini, 2021). In addition, the problem based learning model is also very relevant to use today, especially to improve 21st century skills. There are several studies that report the effect of the problem based learning model as shown in table 3.

Table 3:- Effect of the problem based learning model.

Competency	Research
Creativity	Mayasari et al., 2016; Rahma Dhiyaul Imaroh et al., 2022; Suharyat et al., 2022; Yanuarni et al., 2021
Critical Thinking	Hamdalia Herzon et al., 2018; Hotimah, 2020; Muslim et al., 2015; Rahmawati et al., 2017; Salamiyah & Kholiq, 2020; Agnesa & Rahmadana, 2022; Yanuarni et al., 2021
Collaboration	Haryati & Wangid, 2023; Ilmiyatni et al., 2019;

	Mayasari et al., 2016; Suharyat et al., 2022; Tri Pudji Astuti, 2019; Yanuarni et al., 2021
Communication	Ashim et al., 2019; Haryati & Wangid, 2023; Mayasari et al., 2016; Suharyat et al., 2022; Tri Pudji Astuti, 2019; Yanuarni et al., 2021

Problem based learning aims to provide real problems to students, study groups, find relevant information, collect information, process data and solve problems given. Problem based learning is considered capable of cultivating a creative, collaborative spirit, developing critical thinking skills and higher order thinking, increasing independence and building teamwork and communication skills (Salamiyah & Kholiq, 2020). So this model is very effectively applied in learning physics to improve quality and support the improvement of 21st century skills.

Conclusion:-

Based on the results of preliminary research on the development of e-module physics based on the problem-based learning model integrated with 21st century learning, it can be summarized as follows: (a) printed books are still dominantly used in schools, there are no teaching materials integrated with 21st century learning, the learning system tends to follow conventional methods ; (b) The average 21st century skills of students are still at a percentage of 68.86% in the sufficient category and must be improved; (c) the average results of the analysis of student characteristics are still lacking and must be increased; (d) The problem based learning model is considered effective for improving students' 21st century skills.

Acknowledgment:-

The authors are very grateful to Directorate General of Higher Education (DIKTI), Ministry of Research, Technology and Higher Education, Indonesia, for the Research Grant (Hibah PTM 2023), No. 143/E5/PG.02.00.PL/2023.

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