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Identification of HOTS Creative Thinking, Science Process Skills and Digital Literacy in Physics Subject

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Abstract

High Order Thinking Skills (HOTS) creative thinking, science process skills and digital literacy of students are important components in learning, especially learning physics. The purpose of this study was to find out how HOTS creative thinking, science process skills and digital literacy of students in two different groups, namely X MIPA 3 and X MIPA 5, at SMAN 8 Muaro Jambi unfold. The data collection instrument used a question sheet for HOTS creative thinking, an observation sheet for science process skills, and a questionnaire for digital literacy. The data analysis in this study was quantitative using descriptive statistics and qualitative using Miles & Huberman. The results of the data obtained are then grouped using a Likert scale. The flow of this research was by preparing instruments and interview sheets, conducting interviews with teachers and students, distributing instruments, analyzing data and obtaining data results. It was found that the HOTS, the science process skills, and the digital literacy in class X MIPA 5 are better than X MIPA 3, with successive values in class X MIPA 5 are 80.25, 83.20 and 72.87 while in class X MIPA 3 is 80.69, 85.40 and 74.81. So from these data, it can be seen that the ability of students to think creatively increases in line with science process skills and digital literacy and vice versa. Science process skills help improve students' creative thinking skills by using practicum-based learning. Digital literacy helps students to get various kinds of physics learning resources, materials, modules, questions, and exercises. Digital literacy also helps students to do online practicum by utilizing digital media and the web. So that the creative thinking skills, science process skills and digital literacy skills of students influence each other.
Keywords: *Creative Thinking; HOTS; KPS; Digital Literacy.*

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INTRODUCTION

When the industrial revolution was still being pursued by the Indonesian government for equity, society 5.0 was re-launched. Society 5.0 is an era initiated by the Japanese government [1]. Society 5.0 is a response to the needs of the industrial revolution 4.0 where humans and technology are aligned to create creative and innovative new opportunities where humans will become objects of innovation and information technology will be equipped with big data processing and artificial intelligence [2]. Society 5.0 is a new concept built on the nation in a smart society based on the mobilization of digital technology and artificial intelligence, augmenting social development and improving the quality of life of individuals, as well as sustainability [3,4]. The development of the era requires all aspects of life to follow well so as not to be left behind by other countries. In facing society 5.0, Indonesia must be prepared to produce quality education products, one of which is by increasing the Higher Order Thinking Skills of students in learning, especially physics learning.

Learning is a process of changing learning outcomes that cover all aspects of life to achieve a certain goal [5]. Physics learning is part of the natural sciences that includes studying natural phenomena that occur. Physics is one of the subjects that deal with various scientific concepts, some of which can be found in everyday life [6]. The obstacle faced by students when learning physics is that they think that physics is something complicated and abstract, so it is difficult to find a solution to the problem [7]. In physics learning, there are several abilities that need to be improved to better understand physics learning, namely Higher Order Thinking Skills (henceforth HOTS), Science Process Skills (henceforth KPS), and digital literacy.

Suprapto, et al define HOTS as thinking activities that involve a hierarchy of cognitive levels from Bloom's Taxonomy in the realm of analyzing (C4), evaluating (C5), and creating (C6) [8]. HOTS are thinking skills that are no longer just remembering, restating, and referring without processing, but the ability to think to examine information critically, creatively, and able to solve problems [9]. The high-order thinking ability of students in Indonesia is still very low, this is evidenced by the 2015 TIMSS results showing that Indonesia is at level 45 out of 48 countries. According to Martina, one of the contributing factors, among other things, is the ability of educators to develop HOTS instruments and the unavailability of instruments specifically designed to train HOTS [10]. So students' HOTS are needed to solve problems creatively, especially in the context of physics development [11].

In addition to HOTS, KPS is a skill needed in physics learning, namely, to support students' understanding through physics practicum. Knowledge, science process skills, and scientific attitudes are important to instill in students because they are in accordance with the objectives of the 2013 Curriculum, which is to provide meaningful learning experiences by developing various attitudes, knowledge, and skills [12]. The results of the TIMSS 2007 assessment in scientific literacy, especially physics, Indonesia is ranked 36th out of 49 countries with a score of 432 and is still below the international average score of 500. The low scientific literacy ability of Indonesian students is generally caused by learning activities that have not oriented to the development of scientific literacy [13-14]. The development of science process skills at the education level must continue to be carried out because in reality there are still many students who do not master science process skills.

HOTS and KPS to improve understanding in physics learning can be improved by digging up various information, materials, and practicum well when students have the ability to operate technological devices and internet networks [15]. Digital literacy is life skills that do not only involve the ability to use information and communication technology, but also social skills, abilities in learning, and critical, creative, and inspiring attitudes as digital competencies. The concept of digital literacy can be used as a measure of the quality of student work in a digital environment and provide scientists with a more effective approach [16]. Digital literacy competencies are important for students in all fields of study [17-19]. However, it turns out that the literacy knowledge of Indonesian digital learners is also still low because there are still many schools in Indonesia that have not yet operated internet devices. UNESCO data showed that only 50% of schools have ICT devices and internet connection.

A similar study by Wibawa and Hariati, science process skills could affect learning outcomes to a high-level category [1,20]. The high-level category is the high-level thinking ability of students in learning, especially learning physics. One of the indicators is creative thinking, which is supported Siwa, et al, stating that science process skills and creative thinking are placed in a high percentage [21]. Creative thinking skills can also be improved by applying digital literacy-based learning. In a similar study conducted by Suryaningsih, teachers can improve students' creative thinking skills, one of which is by applying digital literacy to students [22]. Sriyanto in their research also mentions that digital literacy can involve people thinking critically and creatively [23]. Thus, this study will identify creative thinking skills, science process skills, and digital literacy in class.

HOTS, KPS, and digital literacy have a close relationship in developing students' abilities. Higher thinking skills will help students in a practicum which will develop KPS [14,24]. In addition, HOTS will help students develop digital literacy skills in operating electronic media and be able to operate and utilize the web needed in learning. Although many studies have identified HOTS, KPS and digital literacy, other studies did not identify linear relationships related to HOTS, KPS and digital literacy in one study. Manu, T. S. and Nomleni, for example, examined the relationship between creative thinking and science process skills [25]. Meanwhile Aras examined the relationship between science process skills and digital literacy [26]. In this study, HOTS, KPS and digital literacy were identified in general in physics learning to provide the linkage influence between the three. This study discusses three abilities at once in research so that from this research it can be seen that there are more influences between creative thinking skills, science process skills and digital literacy that are not found in other studies.

The importance of this research for the high school education level is as a forum to improve the ability of students in HOTS, KPS and digital literacy so that teachers can provide follow-up plan to improve these abilities. In overcoming problems related to low HOTS, KPS and digital literacy of students, the identification of these abilities is needed. The benefits obtained from this study are expected to provide information for researchers, as input for teachers [27,28], as this research will produce knowledge of how HOTS, KPS and digital literacy are for students in a school and some of the causes of these problems.

METHOD

The type of research used is a mixed method which is a combination of quantitative and qualitative. The mixed method used is an explanatory model where quantitative data are supported by qualitative ones. The population in this study were students of SMAN 8 Muaro Jambi. From the population, a purposive sampling technique based on certain considerations is used. The considerations made in this purposive sampling technique can vary and depend on the needs of the research to be carried out [29]. The consideration or criteria for the subject in this study were class X students, from two different groups, who had studied the material for straight motion. The subjects for the study were 67 people. More detailed research subjects can be seen in Table 1.

Table 1. Research subject

Class	Students
X MIPA 3	35
X MIPA 5	32

The research instruments used were in the form of HOTS question sheets, observation sheets, questionnaires, and interview sheets. HOTS question sheet to measure students' higher-order thinking skills consists of 5 description questions. The observation sheet consists of 10 statements filled out by the observer on the practicum activities of students. The following Table 2 is a Likert scale category for HOTS questions and observation sheets.

Table 2. Categories Likert Scale HOTS Questions Creative Thinking and Observation Sheets

Interval	Range
0-20	Not Very Good
21-40	Not Good
41-60	Enough
61-80	Well
81-100	Very Good

The questionnaire was used to measure the level of digital literacy of students which consisted of 28 statements using a closed questionnaire. The closed questionnaire is presented with several multiple-choice questions to be answered by respondents [30]. The rating scale used is SS (Strongly Agree), S (Agree), RR (Doubtful), TS (Disagree), and STS (Strongly Disagree). The following is a Digital Literacy Questionnaire Likert Scale Category which can be seen in Table 3.

Table 3. Categories Likert Scale Digital Literacy Questionnaire

Interval	**Range**
21-36	Not Very Good
37-52	Not Good
53-68	Enough
69-84	Well
85-100	Very Good

Structured interviews were used as a data collection procedure, with a list of questions prepared for the interviewees in order to obtain information [31]. The interview sheets were carried out on students and teachers. It consists of 3 topics, namely HOTS, KPS and digital literacy.

Data analysis was carried out on quantitative data and qualitative data. The analysis technique for quantitative data uses descriptive statistics. Activities in descriptive statistical data analysis are carried out by looking for the average (mean), median, minimum value and maximum value in order to obtain an overview of the characteristics of the data [32]. Meanwhile, data analysis from interviews was conducted in accordance to Miles and Huberman's analysis [33]. The activities carried out are data reduction, data display, and verification of conclusions, so that interview results are obtained to support quantitative results. Figure 1 is the performance flow that was carried out in this research.

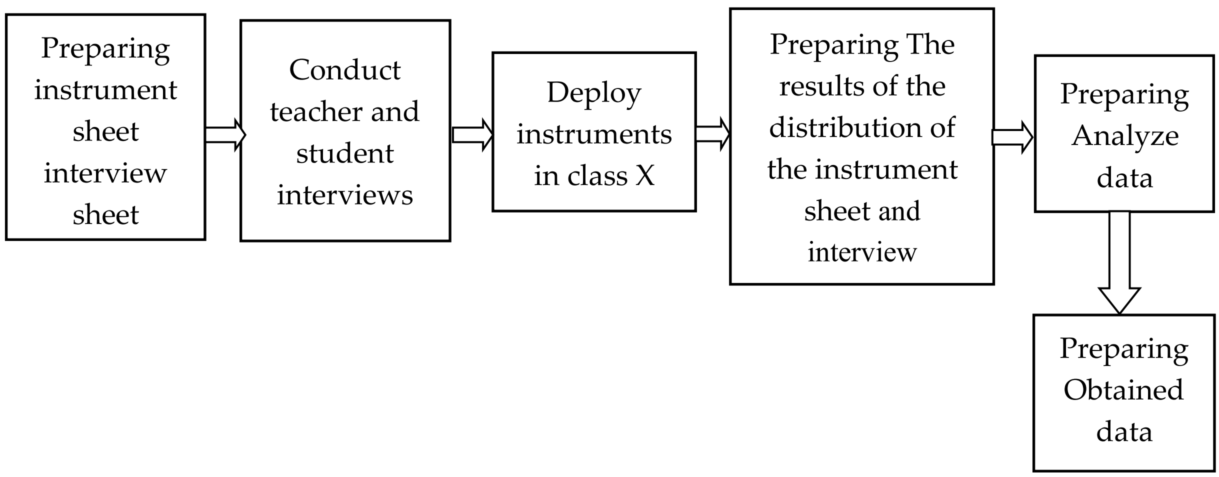

Figure 1. Research Stage

RESULT AND DISCUSSION

The results of the HOTS instruments for creative thinking, KPS and digital literacy were analyzed after all of them had been collected. The analysis conducted by the researcher is descriptive statistics by looking for the mean (average), median, minimum value, maximum value and frequency. The Table 4 describes the acquisition of data results from HOTS creative thinking, KPS, and digital literacy.

Table 4. HOTS Creative Thinking

Class	Range	Clasification Category	Total	Mean	Min	Max	%
X MIPA 3	0-20	Not very good	0	80.25	70	86	0%
	21-40	Not Good	0				0%
	41-60	Enough	0				0%
	61-80	Well	16				45.71%
	81-100	Very good	19				54.28%
X MIPA 5	0-20	Not very good	0	80,96	70	90	0%
	21-40	not good	0				0%
	41-60	Enough	0				0%
	61-80	Well	18				56.25%
	81-100	Very good	14				43.75%
	TOTAL		67				

The results of quantitative data analysis of HOTS in students' creative thinking can be seen in Table 4. In the table, it can be seen that at SMAN 8 Muaro Jambi, class X MIPA 3 has an average HOTS creative thinking value of 80.25, while in class X MIPA 5 has an average HOTS value of 80.69. From these data, it can be concluded that the average value of creative thinking of students in class X MIPA 5 is higher than class X MIPA 3 even though the difference is only 0.44. Nonetheless, the results of the data obtained on the students' HOTS in creative thinking are quite high in class X MIPA 3 and X MIPA 5, especially when it is compared to other research like in Sudesti [34], the students' creative thinking learning outcomes were 22.5%, in

Royani, et al [35] students' creative thinking ability has an average of 59.26, and in research by Dinata [36] it was 50-70. The question sheets given can be understood by some students and can be answered creatively and the data obtained also comes from interviews with teachers and students. The data obtained is strengthened by the results of interviews with students and teachers. The interview is as Table 5 and 6:

Table 5. HOTS Interview Results Creative Thinking with Students

Question	Answer	
	X MIPA 3	X MIPA 5
Do you understand the given Straight Motion problem and can you solve it?	I have a little difficulty in understanding the problem, but in the process I use physics formulas so that it is easier.	I understand some of the questions given and I understand how to solve problems using the GLB and GLBB formulas.
Are there any mistakes you made when solving the given Straight Motion problem?	Exist. I used the wrong physics formula so the results I get are also wrong.	Of course there is. I made a mistake in writing the physics formula and there was one wrong calculation.
Have you checked the answers that have been done and are you sure of the answers that have been done?	Yes, I rechecked the answer I worked on but I'm a little hesitant about the answer.	I re-checked the answers I worked on but there are some questions that I believe are wrong answers.

Table 6. HOTS Creative Thinking Interview Results with Teachers

Question	Answer
How do you apply HOTS learning in class?	I only apply a few HOTS questions because of the ability of students who are less able to apply HOTS questions
Are there any obstacles in implementing HOTS learning in class?	There are several obstacles in implementing HOTS learning, including students finding it difficult to understand the formula that I explain in-class learning
How is the HOTS ability to think creatively of students in learning?	Students are quite active during learning and understand what I explain. However, when they were asked about last week's material the next day they had forgotten.

From the interview, it is found that even though students experience confusion and some obstacles, they still work using existing formulas so that the questions given can be answered even though they are not 100% sure. In improving students' HOTS, educators use HOTS questions several times even though students' abilities are still not too high, aiming to continuously train students' HOTS. Students can solve the problem but cannot apply the formula correctly [37-39].

Table 7. Science Process Skills (KPS)

Class	Range	Clasification Category	Total	Mean	Min	Max	%
X MIPA 3	0-20	Not Very Good	0	83.20	80	88	0%
	21-40	Not Good	0				0%
	41-60	Enough	0				0%
	61-80	Well	13				40.65%
	81-100	Very Good	19				59.37%
X MIPA 5	0-20	Not Very Good	0	85.40	80	90	0%
	21-40	Not Good	0				0%
	41-60	Enough	0				0%
	61-80	Well	7				20.00%
	81-100	Very Good	28				80.00%
	TOTAL		67				

Table 7 shows the quantitative data analysis of students' KPS. In the table, it can be seen that at SMAN 8 Muaro Jambi, class X MIPA 3 has an average value of KPS of 83.20, while in class X MIPA 5 has an average value of 85.40. From these data, it can be concluded that the average value of students' KPS in X MIPA 5 is higher than X MIPA 3, with a difference of 2.2. To help understanding this result, interviews with teachers and students were conducted. The interview is as Table 8 and 9.

Table 8. Results of Science Process Skills Interviews with Students

Question	Answer	
	X MIPA 3	X MIPA 5
Have you done any practical activities before?	Never.	Not at all.
In your opinion, is it important to do practical activities in physics subjects? Why?	Very important. Because it helps in learning.	Very important. Because it can deepen the lesson and master the material

Table 9. Results of Science Process Skills Interview with Teachers

Question	Answer
Does SMA 8 Muaro Jambi have a physics laboratory?	SMA 8 Muaro Jambi has a physics laboratory with quite complete equipment.
Do you think that practicum can help students learn?	Of course, it can help because they do it directly or see firsthand how the physical process occurs so that the knowledge that can be obtained is more attached to the brain longer.
Is there an LKPD for physics subjects in Straight Motion?	Already available.

In other research, Syah, et al shows that the students' KPS is 9,8 in the low category, Putri, et al found the precentage of student's KPS is 31.82 %, and Safahi, et al explained that the learning with practicum improves students science process skills seen from their learning outcomes [40-42]. However, the KPS of students in this research are considered quite high in both class X MIPA 3 and X MIPA 5. Yet, their KPS can be improved through practical activities. Research have found that if practicum activities are not held, it will affect students' skills and also affect their understanding of concepts; then during teaching and learning activities students still tend to be passive and do not explore in-depth learning [14, 43, 44]. Regardless of their zero experience in practicum, the student worksheet given during the research can be followed well, even though students still have difficulty in calculating the data. The high value of students' practicum is due to the motivation of students to carry out physics activities directly so that it can affect their abilities. This is shown in the Straight Movement practicum, the understanding and HOTS of students increase. According to the teacher, the practicum can help because they do it directly or see firsthand how the physical process occurs so that the knowledge obtained is more embedded in the brain. Practicum has never been carried out in X in physics subjects before due to the teacher pursuing material targets, so practicum activities that take a long time have never been carried out.

Table 10. Digital Literation

Class	Range	Clasification Category	Total	Mean	Min	Max	%
X MIPA 3	21-36	Not Very Good	0	72,87	64,29	80,71	0%
	37-52	Not Good	0				0%
	53-68	Enough	4				12,50%
	69-84	Well	28				87,50%
	85-100	Very Good	0				0%
X MIPA 5	21-36	Not Very Good	0	74,81	62,29	80,71	0%
	37-52	Not Good	0				0%
	53-68	Enough	0				0%
	69-84	Well	35				100%
	85-100	Very Good	0				0%
	TOTAL		67				

Table 10 displays the analysis of quantitative data from students' digital literacy. In the table, it can be seen that students of class X MIPA 3 have an average digital literacy score of 72.87, while X MIPA 5 students have an average digital literacy value of 74.81. From these data, it can be concluded that the average value of students' digital literacy in class X MIPA 5 is higher than class X MIPA 3, with a difference of 1.94. To find out more about students' digital literacy, the researchers also conducted interviews with a number of students and physics teachers. The results of the interview are as Table 11 and 12.

Table 11. Student Interview Results

Question	Answer	
	X MIPA 3	X MIPA 5
Have teachers ever used computer digital media in teaching?	Once	Once
What media do you prefer to learn using?	Handphone	Computer
Have you ever had a chore at home that you had to search through digital media?	Using handphone	Using handphone

Table 12. Teacher Interview Results

Question	Answer
How is the digital literacy of students in classroom learning?	Digital components that have been used in the classroom usually use laptops and students are not very fluent in operating them.
How do you develop students' digital literacy?	I apply to students to access material, sample questions or practice questions on the web and it so that they are more proficient in finding information that is not in books.
How do students respond if students' digital literacy is applied?	Students are certainly interested if learning is followed by digital media rather than books. Students pay more attention to learning and no one falls asleep in class.

Based on the results of interviews with students, students have also used digital media to support learning and teachers have also trained students to develop digital literacy during learning. However, the digital literacy of students can still be said to be low, especially compared to research by Faelasofi, Rofiqoh, et al, and Putri, that found that their students' digital literacy skills are in a good category [45-47]. Mastery of digital literacy in the context of learning is very significant [48,49]. Furthermore, it can prepare students in the world of work [50].

The ability of students in social skills has an influence on the HOTS of creative thinking of students. Students who carry out practical activities will better understand the material and concepts explained by the educator so students' HOTS of creative thinking will be higher. This can be seen from the results of the HOTS data that creative thinking in class X MIPA 5 is higher than class X MIPA 3 and class X MIPA 5 has better KPS than X MIPA 3 students. This is reinforced by research that there is a relationship between KPS and HOTS, in which if KPS is high, HOTS is high, otherwise, if KPS is low, HOTS is low [51-53]. Meanwhile, HOTS creative thinking also has an impact on students' digital literacy. The more advance the digital literacy students have, the higher the students' HOTS will be. This is because students can find sources of information or lessons and practice questions that cannot be found in books as long as the students know how to access broad discussion and various learning sites provided over the internet. Over this reason, it can be said that students' HOTS creative thinking, KPS and digital literacy in class X MIPA 3 and X MIPA 5 at SMAN 8 Muaro Jambi have great value.

Research on HOTS creative thinking, KPS and digital literacy have an impact on reader literacy in education. HOTS creative thinking, KPS and digital literacy will help students understand physics learning more easily and interestingly. Research have been conducted that HOTS-based learning outcomes bring changes in circumstances for the better, in a way that it is useful for increasing knowledge, better understanding of unknown information, thus further developing skills [43,54,55]. Learning with hands-on practicum can help students increase their understanding in learning physics, which increases their KPS. While digital literacy can help students access learning with practicum through the web such as Matlab, materials, and physics questions that can help students understand physics learning.

The learning applied by teachers to improve KPS with practicum can also improve students' creative thinking skills. This is in accordance with research conducted by Rini, Beddu, and Chasana that state that the influence of KPS can increase other factors like creativity and vice versa [56-58]. In this study, KPS carried out through practicum helped students to think creatively in arranging experiments using scientific methods and researching so as to find conclusions and updates in their experiments. Experiments or practicum are useful for developing science process skills [59]. Students' creative thinking skills can increase and, if applied continuously, students can solve physics problems that require high-level thinking skills, especially creative thinking, more easily.

Digital literacy can help students achieve the goals of learning. A research by Markawi [60] concluded that digital literacy skills in order to master the use of digital media are needed to streamline learning outcomes. A similar study was also conducted by Hodosyova et al [61] which concluded that students can access and assess information, use and manage information and be able to apply technology effectively. Digital literacy by teachers is developed by means of learning that utilizes digital media and this is in line with research conducted Saputro, et al [62] namely digital literacy can be developed through learning in various ways, for example by directing students to find sources of information in digital form that are related and teach students to use online learning applications.

The novelty in this research is that there is no research that identifies creative thinking skills, KPS and digital literacy in physics subjects that can improve students' abilities. Proven in this study, students' abilities increase in harmony. Also in this study, readers or other researchers can obtain information about how creative thinking skills, scientific process skills and digital literacy are unfolded in new physics learning.

This study only examines 2 classes in one school so that the creative thinking skills, KPS and digital literacy of students in other schools may show different abilities. Another limitation in this study was that students who filled out question sheets and questionnaires did not fill them in seriously due to time constraints in filling out question sheets and questionnaires. In short, it is the breadth of the scope that becomes the difficulty the researchers faced in conducting this research.

The short-term impact of this research in the field of physics is to be able to find out how students' creative thinking skills, scientific process skills, and digital literacy work in harmony and influence each other. These three components are very important in learning physics because creative thinking skills can help students understand physics material that is considered difficult, science process skills can help students deepen physics material that often occurs in everyday life, and digital literacy can help students to make good use of digital media. So that this research can be considered as a preliminary study material in developing a discussion with the theme of HOTS, KPS and digital literacy. The long-term impact of this research in the field of physics is that after knowing how creative thinking skills, KPS and digital literacy of students are, teachers can develop strategies to improve these abilities in every class in the school so that students' creative thinking skills, KPS and digital literacy ability can escalate. Readers can find new information and other researchers can use this research as a reference for further research. This can also provide human resources who will later have a better ability in the field of physics so they can compete with global citizen.

CONCLUSION

Creative thinking skills, science process skills and digital literacy skills of students influence each other. Science process skills, mentioned repetitively as KPS in this research, which are more often improved by practical activities, foster students' creative thinking skills in learning physics. Likewise, with good digital literacy, students can take advantage of advances in information and communication technology in a positive direction. Especially in physics learning, with good digital literacy, students can look for various kinds of physics learning resources and students will have no difficulty in conducting practicals that require digital media usage. This research is expected to be a reference for further research related to creative thinking skills, scientific process skills, and digital literacy of students. Furthermore, it is hoped that this research can also help teachers provide solutions to improve students' creative thinking skills, scientific process skills, and digital literacy skills.

AUTHOR CONTRIBUTIONS

Astalini: conceptualization, methodology. Darmaji: supervision, script finalization, data editing. Dwi Agus Kurniawan: collecting data, processing data, editing data. Minarsih: compiling manuscripts, collecting data, collecting various sources of quotations. All authors have read and agree to the published version of this manuscript.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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