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How do elementary school teachers shape their students' self-regulated and creativity in learning mathematics?

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ABSTRACT

So far, mathematics learning has only focused on a curriculum that prioritizes outcomes over processes, so attitudes are rarely the target of learning. In fact, a positive attitude, especially self-regulated and creativity, is needed in learning mathematics and must have been formed since elementary school. This research, with the aim of describing efforts to establish independence and creativity in learning mathematics by elementary school teachers in West Kalimantan, uses a qualitative descriptive method with a questionnaire as a research instrument. The results of the study show that: i) the formation of self-regulated learning by the teacher is very good, especially in the indicators of disciplined behavior. However, it needs to be improved on indicators of behaving based on one's own initiative; and ii) the formation of learning creativity by the teacher is very good, especially on the indicator of having a great curiosity. However, it needs to be improved on indicators of diligent behavior and not getting bored easily.

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1. INTRODUCTION

A lesson should not only focus on results in the form of knowledge and skills but also on students' positive attitudes towards learning. Two of the positive attitudes in question are self-regulated learning and creativity. Self-regulated learning and creativity are two positive attitudes in learning that are interrelated and influence one another. A research result states that 37.6% of student self-regulated learning is influenced by creativity and learning motivation [1]. On the other hand, information was obtained that the level of self-regulated learning of students affected the level of ability to think creatively mathematically and the level of self-confidence of students [2]. Learning objectives will not be achieved if these two attitudes are not formed in students during the learning process.

Learning mathematics is often considered to be central to determining one's success in all subjects. Someone who has good learning outcomes in mathematics is believed to have good learning outcomes in other subjects [3], [4]. In addition, mathematics is also one of the lessons given at every level of education, from elementary to tertiary institutions [5]. Mathematics learning also facilitates students to have the ability to think logically, analytically, systematically, critically, creatively, and to work together [6], [7]. In fact, the results of other studies state that the factors that influence mathematics learning achievement are self-regulated learning and learning creativity [8]. Based on this explanation, we can conclude that students learn independence and creativity for the first time through the process of learning mathematics.

So far, mathematics learning has only focused on a curriculum that prioritizes results rather than processes, so attitudes are rarely the target of learning. The tendency for students' positive attitudes toward learning can lead to better changes if there is exemplary conditioning by teachers who have persistence and maximum effort. In fact, self-regulated learning and creativity should have become important topics discussed by education stakeholders [9]–[11]. However, the results of a preliminary study of 60 teachers teaching mathematics in West Kalimantan in 2021 show facts that are not as expected. 57% of the teachers who were respondents revealed that they put more emphasis on the target results than the teaching process. This resulted in the creativity of students in learning mathematics being classified as weak, as seen from the number of students who failed to solve problems in alternative ways and were less than optimal in solving math problems. Students also tend not to be independent in learning because they are too dependent on what is taught by the teacher, are not confident enough to explore the insights they have, and are too concerned with the value of the result.

Self-regulated learning is the ability to monitor, regulate, and control aspects of cognition, motivation, and one's own behavior in learning [12]. Indicators of self-regulated learning include several attitudes, namely: independence from others, having self-confidence, behaving disciplined, behaving on your own initiative, and exercising self-control [13]. Meanwhile, learning creativity is the ability possessed by students to discover new things based on data, information, or elements that can be used to solve problems in the learning process [14]. Student learning creativity is measured based on several indicators, namely: high curiosity, not easily bored and diligent, self-confident, feeling challenged by pluralism or complexity, and divergent thinking [15].

A positive attitude toward learning, especially independence and creativity, must be formed as early as possible, namely at the elementary school level, so that it can be useful and even developed at the next level of education. This shows how important independence and creativity are for students to have and improve in learning mathematics. Therefore, this research was conducted with the aim of knowing how elementary school teachers in West Kalimantan shape their students' independence and creativity in learning mathematics which will be seen from how their self-regulated, high curiosity, perseverance, confidence, being challenged by plurality or complexity, and divergent thinking. It is hoped that the results of this study can become a reference as well as evaluation material for the formation of more optimal student self-regulated learning and creativity.

2. METHOD

2.1. Research approach, subjects, and procedures

Qualitative descriptive research was used in this study with the aim of describing the phenomena that occur in research subjects based on the data collected without intending to generalize [16]. The subjects in this study were 262 elementary school teachers from 8 districts or cities in West Kalimantan. Sample selection was based on the observation of average learning outcomes on the subject of mathematics in each district. This number is considered sufficient for use because the minimum adequate sample is in the range of 20-30 samples or more [17].

There are three stages in this research, namely the preparation, implementation, and final stages. During the preparatory stage, a field survey was carried out, an analysis of supporting conditions was conducted, and a research permit was processed. At the implementation stage, communication was carried out with related parties, holding workshops related to the formation of self-regulated learning and creativity, distributing, and filling out questionnaires, as well as collecting and processing data, while at the final stage, the preparation of reports was carried out.

2.2. Data collection techniques and tools

The data collection technique used is a non-test technique. The tool used is in the form of a questionnaire for forming independent and creative attitudes by teachers, which is distributed to elementary school teachers throughout West Kalimantan, both in print and via Google Form. Before being distributed, the questionnaire has gone through the validity and reliability test stage by producing with $r_{xy} > r_{table}$ at a significant level of 5%.

2.3. Data analysis techniques

Data analysis in this study used qualitative data analysis techniques. Respondents' answers to the questionnaire were processed using a Likert Scale. Each positive statement was scored 4 for always, 3 for often, 2 for rarely, and 1 for never. Meanwhile, negative statements were scored 1 for always, 2 for often, 3 for rarely, and 4 for never. Then, the score obtained is calculated using the formula below. Then, the results are classified according to the level of criteria in Table 1.

$$\text{Score} = \frac{\text{total score obtained}}{\text{maximum total score}} \times 100$$

Table 1. Criteria for forming independence and creativity by elementary school teachers in learning mathematics

Score	Level
81.25-100	Very good
62.5-81.25	Good
43.75-62.5	Not good enough
25-43.75	Not good

3. RESULTS AND DISCUSSION

The results of the questionnaire were analyzed in accordance with Table 1. In general, the score and standard deviation of self-regulated learning and learning creativity were calculated. Furthermore, because self-regulated learning and learning creativity each consist of several indicators, each indicator also calculated the score and standard deviation, presented in Table 2.

Table 2. Scores and standard deviations per attitude and indicators

Attitude	Indicator	Score	Standard deviation
Self-regulated learning (score=87.38 and standard deviation=5.63)	Independence from others	88.17	5.88
	Have confidence	86.78	7.09
	Behave discipline	89.82	3.86
	Have a sense of responsibility for complexity	88.65	5.12
	Behave on your own initiative	86.76	7.05
	Exercise self-control	86.86	4.05
Learning creativity (score=84.40 and standard deviation=7.47)	Have great curiosity	88.59	4.81
	Confident and independent	85.69	5.72
	Diligent and not easily bored	81.18	8.36
	Feeling challenged by plurality or complexity	86.16	3.45
	Dare to take risks	86.08	3.28
	Divergent thinking	84.08	6.40

3.1. How do elementary school teachers in West Kalimantan shape their students' self-regulated learning in learning mathematics?

Based on the results of filling out the questionnaire analyzed in accordance with Table 1, it was found that the formation of independent learning by elementary school teachers in West Kalimantan in learning mathematics was classified as very good with a score of 87.38 with a standard deviation of 5.63 (smaller than the score). That is, the scores for each statement containing indicators of independence do not vary too much and tend to be close to the average (score). Therefore, it can be concluded that the formation of self-reliance in elementary school students in West Kalimantan in mathematics learning by their teachers tends to be very good, both in terms of each statement item and in terms of each indicator.

Of the several indicators of self-regulated learning, the order of indicators with the highest to lowest scores is: disciplined behavior, having a sense of responsibility, complexity, independence from others, exercising self-control, having self-confidence, and behaving on one's own initiative. The score for the disciplinary behavior indicator is 89.82, with a standard deviation of 3.86. Discipline behavior is formed by elementary school teachers in West Kalimantan by ensuring students do their own assignments, conditioning students to be involved and actively participating in learning, and trying to keep the academic atmosphere conducive. This is in accordance with the opinion that discipline in learning can be seen when students are able to organize themselves, maintain focus, and follow the learning process consistently and responsibly [18]. With the formation efforts carried out by elementary school teachers in West Kalimantan, students should already be actively involved in the learning process, follow a set study schedule, manage their time wisely, manage their own tasks, be able to ignore things like social media or games, and still focus on their learning goals [19], [20].

The score for the indicator of having responsibility for complexity is 88.65, with a standard deviation of 5.12. For students to have complex responsibilities, elementary school teachers in West Kalimantan shape them by ensuring that the assignments given are done by the students themselves, giving freedom to students to explore assignments, and providing equal opportunities to all students. This effort is in line with the opinion that the responsibility for complexity in learning mathematics refers to students' ability to solve complex mathematical problems by breaking down these problems into smaller parts, recognizing

patterns and relationships between mathematical concepts, and using appropriate problem-solving strategies [21]. With the efforts made, elementary school students in West Kalimantan are expected to be able to analyze problems by associating relevant information, understand quite complex concepts, be able to use various approaches as strategies to solve problems, and not give up easily when facing difficulties [22], [23]. The problems and level of complexity referred to are, of course, still in accordance with the level of student education. However, there are still efforts to form complex responsibilities that must be increased by elementary school teachers in West Kalimantan because the implementation is still not optimal, namely giving students freedom to explore assignments. There were still 56.5% of elementary school teachers who were respondents in this study who said they did not always give students the freedom to explore assignments. This can limit students' ability to find their own strategies for solving math problems.

The score of independence from others is 88.17, with a standard deviation of 5.88. The efforts of elementary school teachers in West Kalimantan to ensure that their students do not depend on other people include ensuring that the assignments given are done by the students themselves, conditioning students to be actively involved in learning, and not keeping their distance from students in the learning process, which is in line with the independence criteria according to Zimmerman, namely that students are able to work independently and not depend on help or direction from others [24]. Students who cannot depend on others do not need any help at all. However, they can take advantage of resources and assistance when needed and still have the main responsibility for learning by taking independent steps during the process of learning mathematics [25]. However, there are still many teachers who keep their distance from students so that the concept of independence from others cannot be maximally instilled in their students.

The score on the self-control indicator was 86.86 with a standard deviation of 4.05. For students' self-control to develop properly, elementary school teachers in West Kalimantan carry out various efforts such as encouraging and strengthening students to ask questions, not keeping a distance from students during the learning process, and conditioning the academic atmosphere to remain conducive. When students are trained to be ready to ask questions, they must also learn to control themselves so that they remain polite in asking questions, asking only for things that are useful and not detrimental to others, and many other things to maintain a conducive learning atmosphere. Teachers who do not keep their distance from students also shape students to be more able to control themselves, so they do not interact with teachers beyond reasonable limits. This is in accordance with Duckwort's opinion that student self-control refers to students' ability to organize and control themselves in learning mathematics [26]. Students with very good self-control will have the ability to manage time well, maintain focus on the tasks at hand, and control emotions during the learning process) [27], [28]. However, there were still around 49.6% of the teacher respondents who stated that they kept their distance from students can make students' self-control decrease, so that this can be an evaluation to increase self-control in the future.

The score for the indicator of having confidence is 86.78, with a standard deviation of 7.09. The formation of self-confidence by the teacher includes conditioning in learning so that students can always participate, actively ask questions, and have the freedom to take alternative routes or explore assignments. When the formation effort is successful, students will have high self-confidence. The characteristics of students who have high self-confidence include: believing that they have effective problem-solving skills and strategies [21]; believing that they can learn independently and are able to overcome difficulties and gain the necessary understanding by their own efforts [23]; and not giving up easily when facing failure in learning mathematics and being able to learn from mistakes to achieve the expected progress [29]. One way to increase self-confidence is to accustom students to having alternative ways other than those taught when solving math problems. However, the results of the study showed that 68.3% of respondents said they did not always give students the opportunity to take alternative routes. In addition to the level of student self-confidence, teachers who do not free students to take alternative ways also make indicators of behavior based on their own initiative get the lowest scores when compared to other indicators of self-regulated learning.

The indicator score for self-initiative behavior is 86.76, with a standard deviation of 7.05. This indicator is formed by the teacher by encouraging and strengthening students to ask questions, giving freedom to students to explore assignments and take alternative ways, and providing equal opportunities to all students. If the student's initiative is very good, then the student will have a willingness to learn, increase knowledge, find solutions to understand the material, set priorities, be responsible, be able to identify problems and solve them in creative and innovative ways, not be afraid to take risks, try new ideas, and overcome challenges confidently [30], [31]. Students who are not given the freedom to take alternative ways of solving math problems become less skilled at taking risks, so this must be corrected.

Based on the results of the research that has been done, the formation of independence for elementary school teachers in West Kalimantan in learning mathematics has been very good, with three indicators that get the highest scores being disciplined behavior, having complex responsibilities, and independence from others. These results are also supported by several research results that state that students who are more disciplined in learning tend to be more independent and organized in learning mathematics,

students who have complex responsibilities tend to take initiative and overcome obstacles in learning mathematics, and students who do not depend on others tend to be able to solve problems without relying on external assistance [32]–[34]. Regularity, initiative, and independence will be the main foundations for forming student independence.

3.2. How do elementary school teachers in West Kalimantan shape their students' creativity in learning mathematics?

Based on the results of the study, the formation of creative attitudes carried out by elementary school teachers in West Kalimantan in learning mathematics is very good, with a score of 84.40. The score is the average score of the 13 statement items that contain indicators of the formation of creative attitudes in the questionnaire distributed. The standard deviation is 7.46 (smaller than the average of 84.40). That is, the scores for each statement containing indicators of the formation of creative attitudes do not vary too much and tend to be close to the average. If we look at the scores per indicator (see Table 2), we get very good criteria for five indicators and good criteria for one indicator. All indicators have a smaller standard deviation than the average score.

Creativity will emerge when a person has sufficient independence. Independence gives individuals the freedom to follow their personal interests and inspirations, enabling them to experiment, think critically, and explore new ideas without depending on external directions or limitations [35]. Therefore, it is natural that a person's creativity is not as high as his independence, because independence is one of the initial conditions for the emergence of creativity. Someone who is independent is not necessarily creative, but someone who is creative is usually definitely independent. However, keep in mind that independence is only one of the factors that can influence creativity, not the only factor that is relevant in the formation of one's creativity.

The results showed that the formation of creative attitudes carried out by 262 elementary school teachers who were the subject of the study had the lowest score on the indicator of being diligent and not easily bored, with a score of 81.18 and a standard deviation of 8.36, and good criteria. Perseverance and not getting bored easily can be formed by providing opportunities for students to take a different way from what the teacher teaches in doing the questions, paying special attention to students who have strengths, and utilizing various methods or media such as songs and other arts. If all students are given the same treatment in learning without considering their potential, then these students tend to get bored easily because they feel that the learning is not in accordance with their abilities or interests. When learning does not pay attention to the needs, interests, and learning styles of students, students will lose motivation, show disinterest, and become bored. Students who are diligent and not easily bored can be seen from their behavior [36]; they do not give up easily when facing obstacles [37]; they actively seek new information, explore topics in depth, and continuously seek new challenges to broaden their understanding [38]; they dare to try different approaches to generating new ideas in the learning process [39]; and they are responsible for their own learning progress [40]. Unfortunately, the results of the questionnaire show that the teacher's efforts to pay special attention to certain students and utilize a variety of methods or media are quite good, so they must be improved so that they can form a diligent attitude and not get bored easily by students more optimally.

The creative attitude indicator that has the highest score is having great curiosity. Based on the results of the study, it was found that the curiosity formation carried out by elementary school teachers in West Kalimantan on their students was very good, with a score of 88.59 and a standard deviation of 4.81. Formation efforts are carried out in the form of conditioning students to actively participate in learning and be ready to ask questions, and conditioning and modifying learning so that student creativity emerges. Students who are used to being active in learning and ready to ask questions will have great curiosity, because involvement will generate curiosity, and that curiosity will trigger questions. Curiosity is closely related to great curiosity. Curiosity can also arise from learning that is more creative and not monotonous because it causes the emergence of new ideas that can be explored. This is in line with several opinions that state that curiosity can be formed from challenging questions and triggers students to seek deeper understanding [41] and interactive and collaborative learning [42]. Students who have great curiosity tend to ask lots of questions and explore new ideas about the topics being studied, are open to trying new things, are critical of the information they receive, and are enthusiastic about the learning process [43]–[45].

Under the indicator of great curiosity, there is an indicator of feeling challenged by plurality or complexity with a score of 86.16 and a standard deviation of 3.45. Elementary school teachers in West Kalimantan shape these feelings by creating learning that fits students' conditions, giving students the freedom to explore assignments, and modifying learning that leads to student creativity. This is in line with the opinion that pluralism in learning refers to the level of difficulty, diversity, and depth of learning material presented to students. Learning that has the right level of plurality or complexity can stimulate critical thinking, encourage deeper exploration, and develop a more comprehensive understanding [46]. Based on the

results of the study, the efforts made by the teacher were very good. Students who already feel challenged by pluralism or complexity will show persistence in dealing with difficulties caused by the complexity of learning and will always be actively involved in complex learning processes [47].

The risk-taking indicator has a score of 86.08 with a standard deviation of 3.28, which is very good. Elementary teachers in West Kalimantan formed the attitude of students who dare to take risks, including conditioning students to be actively involved in learning, giving them the freedom to explore assignments and using alternative methods, and accepting new ideas to develop creative ideas in learning. With these efforts, it is expected to make students dare to take risks for all the new things they do during learning. Students who dare to take risks tend not to be afraid to leave their comfort zone, dare to express opinions, see failure as an opportunity to learn, are flexible in dealing with new problem-solving strategies, and do not give up easily [47].

The indicators of self-confidence and independence also scored very well, with a score of 85.69 and a standard deviation of 5.72. Efforts to form it include ensuring that the assignments given are carried out by students themselves, conditioning students to always be active in learning, providing opportunities for students to explore assignments in alternative ways, and exploring learning with more creative goals, methods, and media. The characteristics of students with very good self-confidence and independence include having confidence in their own abilities, independence in learning, high intrinsic motivation, resilience in the face of failure, and good adaptability.

The indicator that gets the second-lowest score is divergent thinking. Even so, the criteria are still very good. Divergent thinking is a form of creative thinking that produces different solutions or ideas for dealing with a problem or task. In divergent thinking, individuals develop broad thinking, seek innovative alternatives, and involve free, flexible, and associative thinking [48]. Efforts that have been made by West Kalimantan elementary school teachers to shape this attitude include providing opportunities for students to explore assignments and use alternative ways of answering questions, as well as modifying objectives for learning media so that they seem more creative and varied. Divergent thinking will give students the ability to generate various ideas, openness to different perspectives, the courage to take risks, the ability to explore various solutions, and flexibility in thinking. This allows them to think outside conventional boundaries and generate original and innovative ideas [49].

Based on the results of the research that has been done, it can be concluded that the creativity of elementary school teachers in West Kalimantan in learning mathematics has been very good, with the three indicators that get the highest score being having great curiosity, feeling challenged by pluralism and complexity, and being willing to take risks. While the indicator with the lowest score is diligent and not easily bored.

4. CONCLUSION

Based on the research that has been done, several conclusions can be drawn, namely: (i) the formation of independence of elementary school teachers in West Kalimantan in learning mathematics is already very good, with three indicators that get the highest scores being disciplined behavior, having complex responsibilities, and independence from others. While the indicator that gets the lowest score is behaving based on one's own initiative, (ii) the creativity of elementary school teachers in West Kalimantan in teaching mathematics has been very good, with the three indicators that scored the highest being having great curiosity, feeling challenged by pluralism and complexity, and being willing to take risks. While the indicator with the lowest score is diligent and not easily bored. Recommendations that can be given by researchers regarding this research are elementary school teachers in West Kalimantan still need to increase their efforts to form the independence of their students, especially on indicators of behavior based on their own initiative and to shape the creativity of their students, especially in the indicators of diligent behavior and not getting bored easily.

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