Correlation Between Learning Motivation and Mathematics-Creative Thinking Ability

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Abstract. The research aims are as follows: describing the student's learning motivation and mathematics-creative thinking ability; testing their correlations; and calculating the contribution percentage of the learning motivation to the increase in the student's mathematics-creative thinking ability. The total sample size is 619 students from ten primary schools. Data was collected by two methods, as follows: a questionnaire and a test. There are sixteen questions in the learning motivation questionnaire and one open-ended question on the student's mathematics creative thinking ability test. The data is analysed quantitatively. The correlation between the learning motivation and the students' mathematics-creative thinking ability was analysed by using Pearson Product-Moment Correlation with $\alpha = 5\%$ and $N = 619$. The research showed that learning motivation and five of its indicators have positive and significant correlations and have contributed to the increase with a student's mathematics creativity ability and three of its indicators.

Keywords: learning motivation, correlation, mathematics, creative thinking ability.

1 Introduction

Motivation is defined as an individual's will, desire, and desire to encourage others to engage in activities [1]. Motivation plays an important role in the learning process [2], because motivation can foster self-motivation, curiosity, and being active in learning, so that students are encouraged to study more seriously [3]. Learning motivation is a psychological condition that encourages someone to do something, and also acts as a driving force to cause learning activities so that learning objectives will be achieved [4-7]. Motivation is an urge to learn according to needs and the necessity to become an educated and knowledgeable person with essential goals [8].

Some students' own-self learning motivations are as follows: the desire to acquire skills, obtain information and understanding, develop an attitude to succeed, and enjoy life [6]. Students' learning motivation can be moved in some ways as follows: giving points; working in a group; assessments; field trips and excursions; educational films; learning through radio; clear goals; great interest; giving prizes; competing; giving tests; compliments [6, 8-9].

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There are some indicators to measure motivation as follows: the desire [10] and the wish to succeed; the encouragement and needs in learning; the hopes and aspirations for the future; the learning appreciation; and interesting activities [11]. The desire and wish for success have five sub-indicators as follows: active to learn, nice to learn, not hopeless to learn too quickly, not satisfied with the results obtained too quickly, and tenacious to face the learning difficulties [7]. The drive and needs for learning have four sub-indicators as follows: having clear learning goals, being curious, having feedback, and being interested in learning. Hope and ambition for the future have two sub-indicators as follows: looking for things related to learning and perseverance in learning. The interesting learning activities have three sub-indicators as follows: avoiding punishment, receiving praise (an award), and achieving in class. A conducive learning environment has two sub-indicators as follows: comfortable learning place, and interested in teacher's teaching way in class. Curiosity means that learning is not just knowing but also exploring further to give meaning to what is obtained in the learning process [12-15]. Curiosity is needed to get the relationship between concepts to solve problems.

Rewards and punishments can affect students' learning motivation [16]. Awards are given to students as expressions of appreciation, while punishments are given to students for wrong actions. Students enjoy receiving awards [17]. Interest in learning and a conducive learning environment had an influence on students' learning motivation. Students who do not have an interest in learning and are not supported by a conducive learning environment tend to weaken their ability and motivation to learn.

Students who do not have learning motivations will certainly not carry out the learning activities [18]. Learning motivation greatly influences a student's learning success [19]. An increase in student motivation is directly proportional to an increase in learning outcomes [20]. There is a close correlation between learning motivation and a student's learning outcomes [21].

Learning outcomes are influenced by a student's learning creativity. Creativity is the ability to create something new, to give new ideas in problem solving, to see new relationships between elements [22-29]. Creativity is defined as the process of creating unique, unusual, useful, and adaptable works [25, 30-31]. Creativity as a theoretical approach is a multi-component process that not only involves cognitive and ability aspects but also affective, motivational, and other characteristics through social and cultural interactions [32]. This process gives rise to some new understanding, idea, practical solution, or product that is meaningful to the individual.

Creativity is the result of a creative thinking process. Creative thinking involves several ways in the thought process, including reasoning, association, and disclosure [33]. The thinking process is defined as activities that receive, remember, give critical analysis, and use the results for problem solving. In relation to mathematics, mathematics-creative thinking is a combination of logical and divergent thinking. When someone thinks creatively to solve a problem, intuitive divergent thinking generates many ideas [34-36].

Creative thinking ability has indicators as follows: fluency, flexibility, originality (novelty), elaboration [34, 35-38], and metaphorical thinking [39]. Fluency refers to the quantity of output; flexibility refers to several changes as follows: meaning, interpretation, use of something, settlement strategy, and/or direction of thought; originality (novelty) refers to a unique, uncommon, or unusual product; and elaboration refers to the detailed steps for creating a work plan [40]. Fluency refers to the many correct ideas, responses, or answers; 2)

flexibility refers to the many correct ideas, responses, or answers that come from different viewpoints, approaches, or thinking; 3) originality refers to the many correct ideas, responses, or answers that have unique, novel, or uncommon forms; 4) elaboration refers to the many correct ideas, responses, or answers that have detailed, coherent, or developed problem steps to solve the problems [41].

Motivation and creativity can spur activity and initiative, as well as direct and sustain learning persistence. Learning motivation and students' learning creativity have a positive and significant correlation, with a correlation coefficient of 0.997 [42]. Achievement motivation and creative thinking ability have a positive and significant correlation, with a correlation coefficient of 0.475 and a significant value of 0.000 < 0.005 [43]. Students who have high motivation will also have high enthusiasm for learning [44]. Students motivate themselves to achieve something and are not easily discouraged. Learning motivation and a student's creative thinking ability have significant and strong correlations with the value of r_{xy} (0.665) > $r\text{-}_{table}$ (0.312) and $t\text{-}_{test}$ (5.489) > $t\text{-}_{table}$ (2.024).

1.1 Research questions

The research questions are as follows:
1. What is the student's learning motivation and mathematics-creative thinking ability?
2. Is there any positive and significant correlation between learning motivation and a student's mathematics-creative thinking ability?
3. How much is the contribution percentage of the learning motivation to the increase in the student's mathematics-creative thinking ability?

1.2 Research aims

1. Describing the student's learning motivation and mathematics-creative thinking ability.
2. Testing the correlation between learning motivation and a student's mathematics-creative thinking ability.
3. Calculating the contribution percentage of the learning motivation to the increase in the student's mathematics-creative thinking ability.

2 Methods

The research was held in ten primary schools, namely seven state primary schools and three private primary schools in Medan City-Sumatera Utara Province-Indonesia. This research is quantitative. There are two main variables to be searched for in this research, namely: learning motivation (X), and mathematics-creative thinking ability (Y).

2.1 Population and sample

The research population is all students in primary schools in Medan City. The total sample is 619 students from ten primary schools, with an average of 60–65 students per school. There are 320 female samples and 299 male ones. They are the fifth or sixth grade students in their primary school age group (12–14 years old).

2.2 Data collection methodology

The research data was collected by two methods as follows: a questionnaire and a test. There are sixteen questions in the learning motivation questionnaire, which were arranged according to each indicator and sub-indicator as mentioned in Table 1. There are five choice options in each question of the learning motivation questionnaire to be chosen by the respondents (students), namely from 1 to 5 (scale 5). The number "1" means the lowest learning motivation and the number "5" means the highest learning motivation. A score is given according to the number in the choice option, namely from a score of 1 until 5. The minimum score is one, and the maximum score is five.

There is 1 open-ended question on the student's mathematics creative thinking ability test, which is designed based on the material of two-dimensional figures. An open-ended question has multiple or more than one correct answer.

Validation and reliability tests were also performed for the learning motivation questionnaire. The validation test used Pearson Product-Moment Correlation with $\alpha = 5\%$ and $N = 619$. The reliability test used Cronbach's Alpha with $N = 619$ (the number of respondents) and $n = 16$ (the number of questions). All the sixteen questions in the learning motivation questionnaire are valid with each of $r_{xy} > r_{table}$. The result of the reliability test is 0.947, which is very high [46]. It means that the learning motivation questionnaire is reliable and acceptable.

2.3 Technique for data analysis

The research data is analysed quantitatively. The learning motivation and the student's mathematics-creative thinking ability are analysed by converting the score into a value. The score total of the learning motivation is divided by 5 (maximum score) and then multiplied by 100, with the maximum value of 100 and the minimum value of 0. There are five indicators of learning motivation (X) whose scores are converted into values. They are as follows: desire and wish for success (X_1), drive and need for learning (X_2), hope and ambition for the future (X_3), interesting learning activities (X_4), and a conducive learning environment (X_5).

The quantity of the converted score of mathematics-creative thinking ability is different for each of the three indicators of creative thinking ability (Fluency (Y_1), Flexibility (Y_2), and Novelty (Y_3)). It depends on the difficulty level of giving ideas, responses, or answers. The score total of mathematics-creative thinking ability is divided by 20 for the indicator "fluency", and 33.33 for each of the indicators "flexibility and novelty", with a maximum value of 100, and a minimum value of 0.

The categories of learning motivation and mathematics-creative thinking ability are as follows: very low (0–54), low (> 54–64), moderate (> 64–79), high (> 79–89) and very high (> 89–100) [47].

The correlation between the learning motivation and the students' mathematics-creative thinking ability was analysed by using Pearson Product-Moment Correlation with $\alpha = 5\%$ and $N = 619$. The categories of correlation are as follows: very low (0.000-0.199), low (0.200-0.399), moderate (0.400-0.599), high (0.600-0.799) and very high (0.800-1.000) [48]. The correlation significance test between the learning motivation (X) and the student's mathematics-creative thinking ability (Y) is calculated by using t_{test}, with the condition that $t_{test} \leq t_{table}$ = not significant, and $t_{test} > t_{table}$ = significant.

The contribution of the learning motivation to the increase of a student's mathematics-creative thinking ability is calculated by using the formula of determination coefficient = r^2 x 100%, with r = coefficient correlation [49].

3 Findings

3.1 Students' learning motivation & mathematics creative thinking ability

The results of the students' learning motivation and mathematics creative thinking ability can be seen in Table 1.

Table 1. The results of the students' learning motivation and mathematics creative thinking ability

Variable	Mean (Me)	Standard Deviation (SD)	The number of students in each category (persons)				
			Very low	Low	Mode-rate	High	Very high
X_1	57.906	21.057	357	79	20	84	79
X_2	59.871	20.904	302	72	73	79	93
X_3	55.557	20.221	368	86	20	86	59
X_4	52.526	15.710	431	50	87	43	8
X_5	52.246	21.516	368	109	21	77	44
Y_1	62.359	26.879	229	183	0	54	153
Y_2	54.545	26.510	304	0	221	0	94
Y_3	43.614	28.797	420	0	149	0	50

Table 1 shows that all SDs of research variables are less than the mean (Me). It means that the SD value is getting closer to the Me value. The lower and lower SD values will be getting closer to the Me value, or the higher and higher SD values will be widening the range of data variations. The variable of the drive and need for learning (X_2) has a higher mean (59.871) and the number of students who got very high levels of learning motivation (93 students) than the other variables. The variable of the drive and need for learning (X_2) also has the number of students (73+79+93 = 245 students), or 39.580% of the 619 respondents who have a score/value > 64 or level/category > moderate. It means that the variable "drive and need for learning" (X_2) contributes more to the student's learning motivation than other variables.

Table 1 also shows that the Me value of the student's mathematics-creative thinking ability is different for each of the three indicators. The indicator of fluency has the highest Me value (62.359) and most of the number of students who got the very high mathematics creative thinking ability (153 students) of the two other indicators. It depends on the level of difficulty in giving the variety of unique, novel, and uncommon answers. The indicators of flexibility and novelty need more and more unique/ uncommon answers than the indicator of fluency.

3.2 Correlation test between learning motivation and mathematics creative thinking ability

Table 2 shows the results of the correlation test between learning motivation and mathematical creative thinking ability.

Table 2. Correlation test between learning motivation and mathematics creative thinking ability

Variable (X)	Variable (Y)	r_{xy}	Correlation category	t_{test}	t_{table}
Learning motivation (X)	Mathematics creative thinking ability (Y)	0.7584	High	28.8997	1.6472
Desire and wish for success (X_1)	Fluency (Y_1)	0.7298	High	26.5186	
	Flexibility (Y_2)	0.6211	High	19.6843	
	Novelty (Y_3)	0.6255	High	19.9120	
The drive and need for learning (X_2)	Fluency (Y_1)	0.7297	High	26.5097	
	Flexibility (Y_2)	0.6359	High	20.4661	
	Novelty (Y_3)	0.6103	High	19.1387	
Hope and ambition for the future (X_3)	Fluency (Y_1)	0.5462	Moderate	16.1974	
	Flexibility (Y_2)	0.4327	Moderate	11.9227	
	Novelty (Y_3)	0.5162	Moderate	14.9719	
Interesting learning activities (X_4)	Fluency (Y_1)	0.5390	Moderate	15.8938	
	Flexibility (Y_2)	0.4482	Moderate	12.4554	
	Novelty (Y_3)	0.5031	Moderate	14.4592	
A conducive learning environment (X_5)	Fluency (Y_1)	0.5528	Moderate	16.4777	
	Flexibility (Y_2)	0.4554	Moderate	12.7073	
	Novelty (Y_3)	0.4891	Moderate	13.9279	

Table 2 shows that all r_{xy} values of variables are positive, and the t_{test} values of variables are greater than t_{table}. It means that 1) there is a positive and significant correlation between learning motivation (X) and mathematics-creative thinking ability (Y); 2) there is a positive and significant correlation between desire and wish for success (X_1) and fluency (Y_1); there is a positive and significant correlation between desire and wish for success (X_1) and flexibility (Y_2); and there is a positive and significant correlation between desire and wish for success (X_1) and novelty (Y_3); 3) there is a positive and significant correlation between the drive and need for learning (X_2) and fluency (Y_1); there is a positive and significant correlation between the drive and need for learning (X_2) and flexibility (Y_2); and there is a positive and significant correlation between the drive and need for learning (X_2) and novelty (Y_3); 4) there is a positive and significant correlation between hope and ambition for the future (X_3) and fluency (Y_1); there is a positive and significant correlation between hope and ambition for the future (X_3) and flexibility (Y_2); and there is a positive and significant correlation between hope and ambition for the future (X_3) and fluency (Y_3); 5) there is a positive and significant correlation between interesting learning activities (X_4) and fluency (Y_1); there is a positive and significant correlation between interesting learning activities (X_4) and flexibility (Y_2); and there is a positive and significant correlation between interesting learning activities (X_4) and novelty (Y_3); 6) there is a positive and significant correlation between a conducive learning environment (X_5) and fluency (Y_1); there is a positive and significant correlation between a conducive learning environment (X_5) and flexibility (Y_2); and there is a positive and significant correlation between a conducive learning environment (X_5) and fluency (Y_3).

3.3 Learning motivation's contribution to the improvement of students' mathematics-creative thinking ability

The contribution of learning motivation to the increase of students' mathematics creative thinking ability can be seen in Table 3.

Table 3. Contribution of learning motivation to the increase in students' mathematics creative thinking ability

Variable (X)	Variable (Y)	Determination coefficient	Contribution (%)
Learning motivation (X)	Mathematics-creative thinking ability (Y)	0.57512	57.512
Desire and wish for success (X_1)	Fluency (Y_1)	0.53266	53.266
	Flexibility (Y_2)	0.38575	38.575
	Novelty (Y_3)	0.39121	39.121
The drive and need for learning (X_2)	Fluency (Y_1)	0.53249	53.249
	Flexibility (Y_2)	0.40436	40.436
	Novelty (Y_3)	0.37251	37.251
Hope and ambition for the future (X_3)	Fluency (Y_1)	0.29835	29.835
	Flexibility (Y_2)	0.18725	18.725
	Novelty (Y_3)	0.26649	26.649
Interesting learning activities (X_4)	Fluency (Y_1)	0.29049	29.049
	Flexibility (Y_2)	0.20092	20.092
	Novelty (Y_3)	0.25309	25.309
A conducive learning environment (X_5)	Fluency (Y_1)	0.30558	30.558
	Flexibility (Y_2)	0.20743	20.743
	Novelty (Y_3)	0.23920	23.920

Table 3 shows that the learning motivation has a contribution of 57.512% to the increase in the students' mathematics creative thinking ability. The variables of desire and wish for success (X_1) and the drive and need for learning (X_2) have the highest contributions (53.266% and 53.249%) of the other variables, to give the fluency of various answer alternatives. The two variables contribute more to increasing the students' mathematics creative thinking ability than the other variable.

4 Discussion

There are some research findings to be discussed in this article, namely: 1) desire and wish for success, the drive and need for learning, hope and ambition for the future, interesting learning activities, and a conducive learning environment contribute to the student's learning motivation. The drive and need for learning have the highest Me value of them all; 2) the Me value of mathematics-creative thinking ability for one student is different in each of its indicators. The indicator of fluency has the highest Me value and most of the students who got the very high mathematics creative thinking ability of the other two indicators (flexibility and novelty); 3) learning motivation has a positive and significant correlation with a student's mathematics-creative thinking ability. Five indicators of learning motivation also have positive and significant correlations with three indicators of creative thinking ability, and 4) learning motivation has a contribution to the increase in the students' mathematics creative thinking ability. Five indicators of learning motivation have also contributed to three indicators of creative thinking ability each. The desire and wish for success, as well as the drive and need for learning, contribute the most to the fluency of various answer alternatives.

First, the research finding (1) is supported by [7], who said that the desire to become an expert and educated individual; learning with an interest; and learning with the feelings of pleasure are intrinsic learning motivations that come from students themselves to support learning. Extrinsic learning motivations include learning for obligations; learning for needs; learning for

rewards; learning for increasing prestige; learning to receive praise from teachers, parents, and friends; and learning to avoid punishment or to get rewards.

According to [8], every student has a different learning motivation. Some students have learning motivation for just avoiding the worst value or teacher's punishment or just getting the high value. Meanwhile, some other students have the learning motivation to really increase their knowledge and insight. Giving praise to motivate the students to learn is much better than being motivated because of avoiding the teacher's punishment. Every student likes praise and dislikes punishment. Giving awards to students for their work accomplishments is an example of praising them. This gives them encouragement to further improve their work performance. In contrast to praise, punishment is given to students with the aim of stopping their negative behavior. The frequency of students' errors is expected to be reduced after being given punishments.

According to [50] opinion in thier research finding, a conducive learning environment can stimulate and motivate students to be interested in learning. The teacher manages the learning situation wisely to motivate them to learn. Teachers give the maximum attention to students, especially those whose learning outcomes are lower than other students. Teachers must be more observant of the students' learning conditions. Teachers should provide motivation and explain the learning objectives, so that students are more motivated to participate in learning activities. Learning motivation plays an important role in supporting the learning spirit to achieve the students' desired learning goals.

Second, the difference in the mathematics creative thinking ability of one student in each of its indicators is caused by the different difficulty level in giving the answer alternatives in each of its indicators. The indicator of novelty is the most difficult level of the 2 other indicators, and the indicator of fluency is the easiest level of the 2 other indicators. The research finding (2) is supported by [51], who said that there are 3 indicators of creative thinking ability, namely: fluency, flexibility, and novelty. The three indicators are distinct and can function independently. Students with diverse backgrounds and abilities have varying mathematical and creative thinking abilities, depending on their ability level or the influence of their environment. Thus, it means that there will be a possible creative thinking level according to the students' learning achievement in each of the 3 indicators of creative thinking ability. There will be students who are able to reach all 3 indicators at once, or 2 indicators, or just 1 indicator. Creativity has different production abilities in each of its indicators, namely: fluency, flexibility, originality, and elaboration [46].

Third, the research finding (3) is supported by some opinions that say that there is a positive and significant correlation between the learning motivation and the student's mathematics creative thinking ability [46, 52-54]. According to [46], learning motivation will increase the desire to learn, so that creativity will also increase. One of the factors that can encourage the individual's creativity is the student's own encouragement (intrinsic learning motivation). Every individual has the tendency or drive within himself to be creative, to realize his potential, to reveal and activate all his capacities. This drive is the primary motivation for creativity when individuals form new relationships with their environment. According to [41] in [46] article, individuals must have intrinsic motivation to do something on their own accord, in addition to being supported by attention, encouragement, and training from the environment.

According to [52], intrinsic learning motivation has a more significant correlation with creative thinking ability than extrinsic learning motivation. It is not dependent on the encouragement and correlation of others, but comes from the students themselves, who always think about the future, full of challenges. According to [53], the higher and higher student's mathematics creative thinking ability also has the higher and higher learning motivation, or vice versa, the lower and lower student's mathematics creative thinking ability also has the lower and lower learning motivation. According to [54], students have a strong desire to learn mathematics for their own progress. They also have the perseverance and tenacity to face the learning difficulties. According to [55], partial learning motivation has a correlation with creative thinking ability. Students with a moderate level of learning motivation also have a moderate level of creative thinking ability.

Forth, the research finding (4) is supported by [56] opinions (2020) that say that the learning motivation has a contribution of 36% to the increase in the students' mathematics creative thinking ability, and the rest of 64% comes from other factors. Learning motivation has a contribution of 34.6% to the student's creativity [53]. According to [57], learning motivation has a 40% contribution to the students' creative thinking, and the rest of 60% comes from other variables. According to [58], having good learning motivation is one way to increase creative thinking. Learning motivation is the driving force or impetus behind the learning activities that will mobilize all abilities, power, and efforts to achieve a desired goal. According to [59], high levels of learning motivation tend to make students enthusiastic about participating in school-based learning activities, whereas students who are easily bored or lazy about participating in school-based learning activities demonstrate a lack of motivation to learn.

5. Conclusion

Every student has learning motivation and mathematics-creative thinking ability with different levels/categories according to their potency and knowledge of each. The variables that contribute to the student's learning motivation are as follows: desire and wish for success, the drive and need for learning, hope and ambition for the future, interesting learning activities, and a conducive learning environment. The drive and need for learning have the highest contribution of them all.

The mathematics-creative thinking ability of one student is different in each of its indicators. The indicator of fluency has the highest value, and most of the students who have very high mathematics-creative thinking ability of the other two indicators (flexibility and novelty).

Learning motivation has a positive and significant correlation with a student's mathematics creativity ability. Five indicators of learning motivation also have positive and significant correlations with three indicators of creative thinking ability. Learning motivation has contributed to the increase in the students' mathematics creative thinking ability. Five indicators of learning motivation have also contributed to three indicators of creative thinking ability each. The desire and wish for success, as well as the drive and need for learning, contribute the most to the fluency of various answer alternatives.

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