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The Influence of Early Mathematical Ability and Learning Cycle 5e Model Assisted by Geogebra to Improve Students' Mathematical Problem Solving Ability and Students' Mathematical Learning Independence

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ABSTRACT

This study examined how early math skills affect mathematical problem-solving and independent learning. This study also examines how the Geogebra-assisted Learning Cycle 5E model affects students' mathematical problem-solving and learning independence. Finally, this study investigates if the Geogebra-assisted Learning Cycle model interacts with students' initial mathematical abilities. This study sought: A comprehensive study is needed to determine how early mathematical aptitude affects arithmetic problem-solving and academic performance. Class VIII SMP Plus Jabal Rahmah Mulia Medan did this research. The experimental class had 19 students and the control class 20. Cluster random sampling is utilized in quasi-experimental designs like this investigation. The Early Mathematics Ability Test (MIA), problem-solving exams, and math independence questionnaires were used to collect research data. A two-way Anova test will examine the data. The study found that various factors affect pupils' arithmetic problem-solving ability and math independence. First, the student's math skill matters. Second, the Geogebra-assisted Learning Cycle 5E paradigm affects math problem-solving and independence. Finally, kids' early math skills (high, medium, or low) did not affect mathematical problem solving or independent learning.

A. INTRODUCTION

Education plays a crucial role in cultivating human resources that possess the capacity to bring about constructive transformations on a national scale. As stipulated in Article 1 Paragraph 1 of Law Number 20 of 2003, which pertains to the National Education System, education is defined as a deliberate and organized endeavor aimed at establishing an environment conducive to learning and facilitating a process through which students can actively cultivate their inherent capacities, encompassing religious and spiritual fortitude, self-discipline, autonomy, individuality, intellectual acuity, virtuous character, and proficiencies that are essential for their personal growth, societal integration, national advancement, and state welfare. Adapting education to the diverse circumstances in which students are studying is of utmost importance. Education plays a crucial and noteworthy role in various aspects. According to Trianto (2011), it is imperative to initiate a comprehensive reform of the national education system, which involves the revision of the curriculum to incorporate curriculum diversification. The significance of renewal is growing in prominence as individuals navigate their integration into society and the professional realm. It is imperative for individuals to effectively apply the knowledge acquired during their educational journey to address forthcoming challenges. The only way to bring about the change that is wanted is via the act of learning. According to Sutianah (2021), "learning can be interpreted as a mental activity that occurs as a result of active interactions between individuals and their environment." These interactions result in relatively permanent changes in cognitive, emotional, and psychomotor components of an individual's personality.

Students who take on the role of learning subjects have the additional responsibility of actively seeking, finding, analyzing, formulating, and solving problems. The teacher's role is limited to that of a facilitator in this type of student-centered learning. (Sormin, 2016) stated that student-centered learning activities, the The role of the teacher as a motivator and facilitator is crucial in creating a vibrant classroom atmosphere. In

addition to imparting knowledge, the success of the teaching and learning process hinges on accurately assessing the students' prior knowledge before commencing the lesson. The efficacy of a pedagogical endeavor, in conjunction with comprehending the subject matter, necessitates accurate knowledge of the student's baseline prior to engaging in the instructional session.

A test known as the initial ability exam is administered to pupils before they begin their formal education in order to determine their current skill levels. The initial abilities of students consist of aspects such as the level of intelligence, creativity, language skills, learning speed, level of learning motivation, attitude towards learning assignments, interest in learning, sentiments in learning, mental and physical conditions, and so on. Because the mathematical content itself is interrelated with one another, it is also important to have A comprehensive comprehension of the initial mathematical proficiency of the students. In accordance with Sormin's (2016) assertion, mathematics is regarded as a fundamental discipline that holds significant significance in the pursuit of scientific and technological proficiency. Furthermore, it assumes a pivotal role in various facets of existence, often referred to as the epitome of scientific knowledge. Mathematics plays a crucial role in the pursuit of scientific and technological mastery, which, in turn, holds significant relevance across multiple domains of human existence. To put it differently, mathematics is the queen of science. Students, on the other hand, frequently report that mathematics is challenging. According to the author Sukoco (2016), "it is no secret that many students do not like mathematics because of the views of their parents, teachers, or those around them who often say that mathematics is a difficult subject."

Students' engagement in mathematics education and the successful completion of educational goals are dependent on a great number of factors being taken into consideration. There are several aspects of a student's environment that play a role in how well they learn mathematics. There are a variety of elements that influence students, some of which are internal (internal) and others that are external (external). The level of expertise of the instructors, the surrounding conditions, and the instructional strategies employed are all examples of external influences. In the meantime, elements that are internal to each individual student include their level of learning independence (Putera, 2019: 72). As a result of learning activities that are common in the field but do not currently accommodate the development of these abilities (Surya, E., 2013), student weaknesses lie in the ability to solve mathematical problems, reasoning, mathematical connections, and communication, as stated by (Hudojo, 2018). Recognizing the fundamental mathematical abilities of students. According to Sormin (2016), the development of science and technology cannot proceed without the utilization of mathematics. It represents the peak of scientific knowledge and is extremely important in many facets of everyday life. The ability to do well in science and technology, both of which have wide-ranging implications for everyday life, requires a strong foundation in mathematics. To put it another way.

It is imperative for students to possess the capability to effectively resolve mathematical problems, while concurrently cultivating a disposition that acknowledges and appreciates the significance of mathematics in various aspects of life. This encompasses possessing an innate inquisitiveness, care, and eagerness in the acquisition of mathematical knowledge, alongside demonstrating perseverance and self-assurance in overcoming mathematical challenges. The acquisition of self-regulatory skills in educational pursuits is a crucial aspect within the affective domains that students must develop. (Ansori, 2019) proposed a number of different definitions of independent learning, some of which are as follows: 1) not being dependent on other people; 2) having self-confidence; 3) exhibiting disciplined behavior; 4) having their own initiative; 5) having a sense of responsibility; and 6) having self-control.

The instructor needs to have sufficient knowledge of the concepts of learning as a basis for constructing teaching and learning activities. These activities include things like formulating objectives, selecting resources, selecting learning models, and setting evaluations, among other things. The learning model that is being utilized by the instructor is one manner in which goals can be communicated to the pupils. According to (Aqib, 2016), learning models can also be regarded as ways, examples, or patterns, and their purpose is to provide messages to students that need to be known, understood, and understood, specifically by constructing a pattern or example with the materials chosen by the teacher. This has the goal of giving messages to students that must be known, understood, and understood. the educators in accordance with the material that is offered and the conditions in the class that are described from beginning to end and are normally presented by the educator in the class.

The Learning Cycle 5E is an educational framework that has its origins in constructivist ideas and places a premium on the students' participation in the active learning process. The method consists of a number of stages that must be completed in a particular order in order to achieve the desired level of competence in relation to active learning competencies. The Learning Cycle 5E learning model is an educational structure

that places a strong emphasis on learning that is centered on the student. It is made up of a number of different stages or phases that have been methodically planned out to make it possible for students to attain mastery in the necessary competencies. This is accomplished through students' active participation in class discussions in which they are prompted to actively seek out and uncover new information on their own. The Learning Cycle 5E learning model is an instructional strategy that places an emphasis on learning that is centered on the student. The integration of science and technology (IPTEK) in educational media can be effectively combined with the pedagogical tactics that are implemented by teachers to improve students' capabilities in mathematical problem-solving and to develop students' independence in mathematical learning. The application of this instructional paradigm has the potential to result in the acquisition of additional benefits.

The authors are interested in conducting research with the following working title: The Influence of Early Mathematical Abilities and the 5E Learning Cycle Model assisted by Geogebra to Improve Students' Mathematical Problem Solving Ability and Students' Mathematical Learning Independence. This interest stems from the description of the problems that was presented earlier.

B. RESEARCH METHODS

This research falls into the category of quasi-experimental research, and the sampling approach used is cluster random sampling. The participants in this study were all students attending SMP Plus Jabal Rahmah Mulia Medan. There were a total of 200 students participating in this study, and they were broken up into three classes of students in class VII, four classes of students in class VIII, and three classes of students in class IX. The samples for this study consisted of a total of 39 students who were enrolled in class VIII. Of these students, 19 were drawn from class VIII Khadijah, which served as the experimental class, and 20 were drawn from class VIII Aisyah, which served as the control class. In this particular investigation, there are two types of variables: independent variables and dependent variables. Early Mathematical capacity (KAM) and learning with the 5E Learning Cycle model are the independent variables in this study. The capacity to solve mathematical problems and the independence of students' mathematical learning are the dependent variables. This study was conducted in the United Kingdom.

C. RESULT AND DISCUSSION

The Effect of Students' Early Mathematical Ability on Students' Mathematical Problem Solving Ability and Students' Mathematical Learning Independence

The results revealed a significant association between students' initial mathematical aptitude and their subsequent proficiency in mathematical problem-solving, as well as their capacity for independent learning. The results of the hypothesis examination are displayed in Table 1 below.:

Table 1. Initial Ability Hypothesis Test Results on Students' Mathematical Problem Solving Ability

Dependent Variable: Solution to problem					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1212.436[a]	31	39.111	1.196	.434
Intercept	236015.179	1	236015.179	7214.438	.000
KAM	817.706	25	32.708	1.000	.546
Class	164.024	1	164.024	5.014	.060
KAM * Class	235.227	5	47.045	1.438	.319
Error	229.000	7	32.714		
Total	274948.000	39			
Corrected Total	1441.436	38			
a. R Squared = .841 (Adjusted R Squared = .138)					

According to the results of the SPSS Test of Between – Subject Effects, which are presented in table 1, the F_count value is 5.014 higher than 3.25; therefore, hypothesis 1 is validated, and it is possible to assert The mathematical problem-solving capabilities of students are influenced by their initial ability scores. Next, we

will have a look at the findings of the test that was conducted to see whether or not beginning ability has an effect on the degree of independence with which kids acquire mathematics. These findings will be provided in table 2 down below.:

Table 2. Initial Ability Hypothesis Test Results on Students' Mathematical Learning Independence

Tests of Between-Subjects Effects					
Dependent Variable: Independence					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1782.192[a]	31	57.490	1.559	.282
Intercept	221022.360	1	221022.360	5992.859	.000
KAM	948.024	25	37.921	1.028	.528
Class	288.095	1	288.095	7.811	.027
KAM * Class	225.545	5	45.109	1.223	.389
Error	258.167	7	36.881		
Total	252441.000	39			
Corrected Total	2040.359	38			
a. R Squared = .873 (Adjusted R Squared = .313)					

In light of the fact that table 2, the output of the SPSS Test of Between – Subject Effects, obtained a significance score of = 0.027 0.05 with a value of F_count>F_table or 7.811 > 3.25, then hypothesis 1 is accepted, and it can be stated that there is an effect of initial ability scores on students' mathematical learning independence.

The Effect of the 5E Learning Cycle Model on Students' Mathematical Problem Solving Ability and Students' Mathematical Learning Independence

According to the findings, there was a relationship between the 5E Learning Cycle model of students and the mathematical problem-solving abilities of students, as well as the amount of independence children demonstrated in their mathematical learning. Additionally, the findings suggested that this connection existed between the level of independence children displayed in their mathematical learning. The results of the test of the hypothesis are summarized in table 3 which can be found further down on this page.:

Table 3. Results of the 5E Learning Cycle Model Hypothesis Test on Students' Mathematical Problem Solving Ability

Tests of Between-Subjects Effects					
Dependent Variable: Solution to problem					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	171.446[a]	1	171.446	4.995	.032
Intercept	273677.908	1	273677.908	7973.359	.000
Learning model	171.446	1	171.446	4.995	.032
Error	1269.989	37	34.324		
Total	274948.000	39			
Corrected Total	1441.436	38			
a. R Squared = .119 (Adjusted R Squared = .095)					

In light of the fact that table 3, the output of the SPSS Test of Between – Subject Effects, obtained a significance score of = 0.032 0.05 and a F_count value of 4.995 > 4.10, then hypothesis 1 is accepted, and it is possible to state that there is an influence of the 5E learning cycle model on the abilities of students to solve

mathematical problems. Following that, we will examine the hypothesis of the influence that the 5E learning cycle model has on the degree of independence with which children learn mathematics. This hypothesis will be provided in table 4 below.:

Table 4. The results of the 5E Learning Cycle Model Hypothesis Test on Students' Mathematical Learning Independence

Tests of Between-Subjects Effects					
Dependent Variable: Independence					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	540.412[a]	1	540.412	13.331	.001
Intercept	250832.719	1	250832.719	6187.424	.000
Model	540.412	1	540.412	13.331	.001
Error	1499.947	37	40.539		
Total	252441.000	39			
Corrected Total	2040.359	38			
a. R Squared = .265 (Adjusted R Squared = .245)					

On the basis of table 4 of the output of the SPSS Test of Between – Subject Effect, a significance score of 0.01 0.05 is obtained with a value of F_count>F_table or 13.331 > 4.10, which indicates that hypothesis 2 is accepted. Therefore, it is possible to state that the 5E learning cycle model has an influence on independent learning student mathematics.

The Interaction Effect of Students' Initial Mathematical Ability and the 5E Learning Cycle Model on Students' Mathematical Problem Solving Ability and Students' Mathematical Learning Independence

According to the findings of the investigation, there was no interaction impact between the beginning mathematical abilities of the students and the 5E studying Cycle model of the students in terms of the abilities of the students to answer mathematical issues and their independence in studying mathematics. This was investigated with regard to the abilities of the students to study mathematics on their own. The results of the investigation into the hypothesis are detailed in table 5 which can be found below.:

Table 5. Initial Mathematical Ability Hypothesis Test Results and the 5E Learning Cycle Model on Students' Mathematical Problem Solving Ability

Tests of Between-Subjects Effects					
Dependent Variable: Solution to problem					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	432.288[a]	5	86.458	2.827	.031
Intercept	134902.590	1	134902.590	4411.431	.000
KAM	123.177	2	61.588	2.014	.150
Learning model	2.122	1	2.122	.069	.794
KAM * Learning model	139.430	2	69.715	2.280	.118
Error	1009.148	33	30.580		
Total	274948.000	39			
Corrected Total	1441.436	38			
a. R Squared = .300 (Adjusted R Squared = .194)					

On the basis of table 5, the following results were obtained from the SPSS Test of Between-Subject Effect:

1. If the significance score is more than 0.05 and the F count is between 2.014 and 3.27, then the hypothesis is not supported, and it is possible to conclude that there is no interaction effect between students' basic mathematical abilities and their ability to solve mathematical problems.
2. If the significance score is greater than 0.05 and the F-count value is less than 4.18, then the hypothesis cannot be accepted; hence, it is possible to assert that the 5E learning cycle model does not have an interaction effect on the ability of students to solve mathematical problems.
3. If the significance score is greater than 0.05 and the F-count value is greater than 2.22, then the hypothesis is rejected, and it is possible to state that there is no interaction effect of early mathematical abilities and the 5E learning cycle model on students' ability to solve mathematical problems. This conclusion can be drawn because the significance score is greater than 0.05 and the F-count value is greater than 2.22.

Table 6. Initial Mathematical Ability Hypothesis Test Results and the 5E Learning Cycle Model on Students' Mathematical Learning Independence

Tests of Between-Subjects Effects					
Dependent Variable: independence					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	734.364[a]	5	146.873	3.711	.009
Intercept	129586.936	1	129586.936	3274.414	.000
Learning Model	204.361	1	204.361	5.164	.030
KAM	81.423	2	40.712	1.029	.369
Learning Model * KAM	112.040	2	56.020	1.416	.257
Error	1305.995	33	39.576		
Total	252441.000	39			
Corrected Total	2040.359	38			
a. R Squared = .360 (Adjusted R Squared = .263)					

According to the results presented in table 6, which were obtained using the SPSS Test of Between–Subject Effect,:

1. If the significance score is more than 0.05 and the F-count is less than 3.27, then the hypothesis cannot be accepted; hence, it is possible to claim that there is no interaction impact of early mathematical talents on the degree to which pupils are able to acquire mathematics independently.
2. If the significance score is less than 0.05 and the F-count value is more than 4.18, then the hypothesis cannot be supported; hence, it is possible to assert that the 5E learning cycle model does not have an effect on the students' ability to learn mathematics independently.
3. Since the significance score is more than 0.05 and the F-count value is greater than 2.22, the hypothesis cannot be supported; therefore, it is possible to assert that there is no interaction impact between early mathematical talents and the 5E learning cycle model on the degree to which students are independent in their mathematical learning..

DISCUSSION

According to the findings of the research and analysis that was carried out, there is, in general, an influence of early mathematical abilities and the Learning Cycle 5E learning model on the problem-solving abilities of students in mathematics as well as the level of independence that students demonstrate in their mathematical learning. Additionally, the Learning Cycle 5E learning model has an effect on the level of autonomy that students demonstrate in their mathematical learning. The findings suggested that there was a connection between learners' initial mathematical ability and their capacity to answer mathematical issues. This was demonstrated by the fact that there was a correlation between the two. This is supported by the fact that the circumstance is reflected by the value of F_count>F_(table), precisely 5.014 > 3.25, which is evidence of the aforementioned point. This is in line with the findings of the research carried out by (Suryani, M., 2020),

which discovered that KAM has an influence on the problem-solving abilities of pupils. This is supported by the fact that this is the case. According to the findings of the study, 75 percent of the students who had initially been categorized as having low KAM improved to having medium KAM, while 25 percent remained in the same position as before. 26% of the students who were initially classified as having a moderate KAM level moved up to having a high KAM level. This represents an improvement in the students' overall knowledge, ability, and motivation. In spite of this, 21% of students dropped to a lower KAM while 52% remained in the same rank as before. The results showed that among the students who had been classified initially as having a high KAM, forty percent of them dropped down to having a moderate KAM, while sixty percent of them remained in the same position. Additional evidence in support of this claim was supplied by researchers (Masri, MF., 2018). The findings of the study revealed that there was an improvement in the problem-solving abilities of students with high KAM who were treated with the PBM learning method higher than those who were given conventional learning treatment; however, there was no difference in the improvement of problem-solving abilities the mathematics of students with low KAM who were treated with the PBM learning method and those who were given the conventional learning treatment; there is a correlation between KAM and improvement in problem-solving abilities the mathematics of students with high KAM and conventional learning treatment

The findings of the research that was carried out by researchers indicate that there is an influence of students' initial mathematical aptitude on students' ability to acquire mathematics independently. This is shown by the fact that the value of F_count>F_table is more than 3.25, which provides evidence that this is the case. This is consistent with the findings of relevant research that was carried out by (Masri, MF., 2018), specifically that there is an interaction between learning methods and KAM on student self-efficacy, and that this shows that student self-efficacy is influenced by learning methods and KAM; the self-efficacy of students with high KAM who were treated with the PBM learning method was higher than those who were given the conventional learning treatment; there is no difference in the self-efficacy of.

D. CONCLUSION AND SUGGESTIONS

Based on the results obtained from the normality test, homogeneity test, and hypothesis testing, the following conclusions can be derived: Two main findings emerged from the analysis. Firstly, there is a statistically significant relationship between students' initial mathematical abilities and their problem-solving skills in mathematics, as evidenced by the F statistic of 5.014, which exceeds the critical value of 3.25. Secondly, there is a significant association between students' early mathematical abilities and their level of independence in mathematical learning, as indicated by the F statistic of 5.0, surpassing the threshold value. The Geogebra-assisted 5E Learning Cycle model has a significant impact on students' mathematical problem-solving abilities, as evidenced by the F_count value of 4.995, which exceeds the critical value of F_table (4.10). Additionally, the Learning Cycle 5E model has a significant influence on students' independence in mathematical learning, as indicated by the F_count value of 13.331, which surpasses the critical value of F_table (4.10). The Geogebra-assisted 5E Learning Cycle model has an impact on students. There is a lack of empirical evidence regarding the potential interaction effect between students' early math abilities (classified as high, medium, or low) and the utilization of the 5E Learning Cycle model, supported by Geogebra, on students' mathematical problem-solving skills and their level of autonomy in the process of learning mathematics. The research findings indicate a relationship between students' initial mathematical abilities and their mathematical problem-solving abilities, as evidenced by a significance score of 0.118, which exceeds the threshold of 0.05. Additionally, the value of F_count (2.280) is greater than the critical value F_(table) (2.22), further supporting the significance of this relationship. Similarly, the research results demonstrate a connection between students' early mathematical abilities and their mathematical learning independence, with a significance score of 0.257, which exceeds the threshold of 0.05. Furthermore, the value of F_count (1.416) is greater than the critical value F_(table) (2.22), indicating the significance of this relationship.

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