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Elementary School Students' Effectiveness towards Improving Mathematics Learning Outcomes in Additional Material

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Abstract. The low results of learning mathematics from year to year give rise to suggestions for students that mathematics is a difficult lesson. This needs to be researched to find out the relationship between mathematics learning attitudes, anxiety, habits, and additional mathematics learning outcomes. Quantitative research method with a survey approach. The subjects were 251 random sampling people. Data collection techniques using instruments adapted from Mathematics Learning Orientation which include attitudes, attention, and mathematics learning habits totaling 51 items. Analysis techniques using correlation and regression with SPSS software version 26.0. The findings show that attitudes, habits, and anxiety are positively and significantly related to mathematics learning. Mathematics learning anxiety has a moderate relationship, while mathematics learning attitudes and habits have a weak relationship to additional mathematics learning achievement. Another finding is that the relationship between anxiety about studying mathematics is the main predictor of additional material, compared to attitudes and habits about studying mathematics. The conclusion is that mathematics learning orientation is one of the factors that plays a very important role in determining the level of student achievement in mathematics. The contribution provides information that students who have a positive attitude in learning mathematics show good study habits, therefore the teacher's role is needed to build a positive attitude.

Keywords: Attitude, Doubt, Habit, Learn Mathematics

1. Introduction

The effectiveness of learning is very important in determining students' academic success. Different human concepts and ideas in learning are normal, honorable, and beneficial for individuals (Ryan & Deci, 2020). According to Jowsey et al., (2020), Learning orientation is an individual quality that influences students' ability to obtain information so they can communicate with peers and teachers during the learning process. In theory, non-cognitive abilities are also important in determining students' success in learning, especially in the mathematics learning process (Zynuddin et al., 2023). Meanwhile, non-cognitive abilities are also known as affective abilities which are realized through Learning Orientation in Mathematics which is viewed from attitudes, attention, habits, problem-solving behavior, and students' learning environment in mathematics (Hwang et al., 2021). In general, in mathematics, there are three affective abilities, namely attitude, anxiety, and additional habits of learning mathematics. The relationship between affective abilities and cognitive abilities can be observed in the ARoS model. This model describes the influence of students' affective variables on the mathematics learning process. Behnamnia et al., (2020) found that attitude, attention, and habits act as important affective abilities in mathematics learning. Affective abilities act as a trigger to create feelings of wanting to learn mathematics, then encourage cognitive abilities to stimulate students to solve mathematical problems. Good and effective mathematical problem-solving allows students to demonstrate high achievement in mathematics. A student's affective abilities function as memory triggers which directly influence cognitive abilities thereby increasing mathematics learning achievement. The issue of student academic success is at the center of attention and is the subject of heated debate among

parents, teachers, and society as a whole. The measure of success of an educational organization is based on the success of students in the academic field. Student success in general examinations is an indicator of the effectiveness of the management of an educational organization. Success in mathematics is exciting and very important in high school (Hillmayr et al., 2020). Achievement in mathematics is often considered a key factor in ensuring student success in the learning process at school (Mishra, 2020).

1.1. Problem Statement

So far, student learning outcomes in mathematics are at both disappointing and encouraging levels. The results of government observations are 60:40, which shows that 60% of students in senior high schools are still low. In 2022, the number of students in the Science (Velazco et al., 2022), Mathematics, and Technology pathway will be 43.18%, indicating that students still fail to master mathematics well, and this has an impact on science and technology abilities, considering that the selection requirements for the Science and Technology pathway require a good foundation in mathematics (Lumbantoruan & Male, 2022). In research Lumbantoruan & Manalu, (2024) students were found in surveys to have low learning outcomes in mathematics learning motivation. The ability to master mathematics requires learning techniques, knowledge, and determination. Mathematics has an abstract nature that leads many students, not only in Indonesia but all over the world, to view it as a difficult and intimidating subject (Staddon, 2022). Another fact, data from the Regional Education Forum shows that the results of Indonesian students' learning exams in mathematics are still far from what was expected. This data is recorded in table 1 below which shows very good results (1A and 2A) in advanced mathematics experienced percentage fluctuations with an average result of 16.30% while failure (9G) was 24.24%. In comparison, excellent performance was found to be lower than failure (Ivorra et al., 2020).

Table 1. Additional achievement in SPM mathematics at the national level

Year	1A-2A	3B to 6C	% Candidate 7D-8E	9G
2014	15.9	30.5	35.1	18.5
2015	16.1	29.7	30.7	23.5
2016	15.1	32.0	29.7	23.3
2017	15.0	29.7	28.5	26.8
2018	16.9	28.6	28.3	26.2
2019	18.3	28.8	27.5	25.5
2020	16.8	28.9	28.5	25.9
Min.	16.3	29.74	29.72	24.24

1.2. Related Research

In previous research, attitudes toward learning mathematics showed that there was a positive relationship between attitude, motivation, and mathematics achievement. Learning attitudes are related to feelings toward mathematics and influence students' motivation, expectations, and interest in mathematics (Primi et al., 2020). Study Sugiman et al., (2020), meanwhile, interest refers to enjoyment, self-confidence, talent, and the lifelong benefits of learning mathematics. Sahin & Yilmaz, (2020) found that a positive attitude toward learning had a strong impact on student motivation. Vidergor & Ben-Amram, (2020) also stated that students who have a positive attitude toward mathematics have a positive perception of the importance of mathematics. Yin et al., (2020) in his research, also found that there was a positive relationship between students' attitudes and their mathematics performance. Maamin et al., (2021) found that a positive attitude towards mathematics was an important and important factor in determining the mathematics achievement of 8th-grade students in Jordan. (Zhang & Wang, 2020) shows that there is a positive relationship between attitudes and mathematics achievement. Vidergor & Ben-Amram, (2020) states that students who have low attitudes toward mathematics tests are also associated with low achievement. Students who have a positive attitude towards mathematics also perform better in mathematics subjects. Datzberger, (2018) in his research shows that attitudes towards mathematics learning have a positive relationship with mathematics learning outcomes and are even the main contributor

to OPM. It is about the student's willingness to accept the challenges of understanding mathematical concepts. Motivation is also associated with students' belief in success (Burić & Kim, 2020). Motivation level is one of the factors that cause students to perform differently in mathematics classes. This is supported by Ibáñez et al., (2020) who states that there are differences in the academic achievement and motivation of secondary school students, with highly motivated students showing better academic performance than low motivated students. Anxiety in learning mathematics. Ching et al., (2020) defines mathematics anxiety as a feeling of uncertainty due to the inability to answer mathematical questions. Define mathematics anxiety as a combination of debilitating test pressure, low self-confidence, fear of failure, and negative attitudes toward regard to learning mathematics. Zhang & Wang, (2020) found that students who did not have math anxiety were highly motivated to learn compared to students who had high math anxiety. This shows that an increase in math anxiety leads to a decrease in achievement. These results are supported by research by Wang et al., (2020) which shows that students who have high mathematics anxiety have low motivation and that conversely, students who have low mathematics anxiety have high motivation. Mohamed et al., (2020)found that most students do not spend enough time studying mathematics regularly and effectively. The results of this study also show that there is a positive relationship between immediate completion of homework, exercises, and homework over time and increased time spent studying mathematics. Moreover, the willingness to do mathematics exercises systematically determines the extent or limits of expressing a particular mathematics learning attitude for mathematics learning habits. Since learning attitudes determine study habits, mathematics study habits can influence students' mathematics learning outcomes. Büchele, (2020) shows that mathematics study habits have a significant positive relationship with mathematics learning outcomes. Mathematics learning theory states that students who perform poorly in mathematics are due to poor study habits and a lack of skills in doing exercises and taking tests. Papadopoulos, (2020) groups student-related variables into three, namely affective, cognitive, and non-intellectual variables, where these variables are very important in further learning of mathematics. Attitudes, motivation, anxiety, habits, and self-concept are very important affective variables. Several previous studies have shown that affective factors such as attitudes, anxiety, and habits are the main factors that influence students' learning and subsequent mathematics achievement (Hwang et al., 2020). A conceptual framework was created to examine the relationship between OPM and incremental mathematics achievement, as shown. This conceptual framework involves three dependent variables, namely attitude, attention, and supplemental habits d learning mathematics. The dependent variable refers to additional results in mathematics (Ömeroğulları et al., 2020).

Tabel 2. Conceptual links between OPM and additional mathematics achievement.

OPM	Realization
Attitudes in learning mathematics. Anxiety in learning mathematics Habits in the study of mathematics	Additional Mathematics

Given the gap in opinion between theory, previous research findings, expectations, and reality in the field, this research wants to see the extent of the influence of affective variables on students' learning outcomes and mathematics achievement by excluding cognitive and non-intellectual variables.

1.3. Research Objectives

The research aims to identify the relationship between mathematics attitudes, anxiety, and study habits with improving mathematics learning outcomes in elementary school students, and to identify variables. Attitudes, anxiety, and mathematics study habits are the best predictors of increasing access to mathematics learning outcomes in mathematics.

2. Theoretical Framework

In the concept of learning, learning is understood as an orientation that brings change to each individual, whether in the form of changes in behavior, acquisition of new knowledge, or

increased understanding. A student will gain knowledge by thinking about something he doesn't know after attending a learning orientation. At the same time, any activity aimed at obtaining knowledge and using it is closely related to the direction of learning. Furthermore, by applying the knowledge gained, it is hoped that it can produce behavioral changes and useful experiences (Radianti et al., 2020). Before carrying out the teaching and learning process, teachers generally have to pay attention to the level of students' learning readiness (Ayanwale et al., 2022). Willingness to learn is one of the factors that influences learning. Preparing lessons is essential to ensure that students benefit from what they learn(Patricia Aguilera-Hermida, 2020). According to Radianti et al., (2020), readiness for learning is the level of mental development required to benefit from experience. This means that students cannot understand a concept if their level of thinking has not reached the desired level. Elfadil & Ibrahim, (2022) divides learning readiness into three, namely cognitive readiness, affective readiness, and psychomotor readiness. Motivation is the willingness to focus, time, energy, and perseverance to learn (Kanat-Maymon et al., 2020). Meanwhile, motivation is a will that requires a person to be focused, and have time, strong energy, and perseverance to learn (Ulia & Kusmaryono, 2021). Anticipation refers to meaningful mathematics learning, such as understanding concepts, knowing theorems and formulas, as well as solving strategies and techniques in the hope of excelling in a math test or exam with additional information (Rossiter et al., 2023). According to (Zhang & Wang, 2020), mathematics anxiety is calculated as a general attitude toward mathematics. Kudinov et al., (2020) characterizes attitudes as anxiety, self-confidence, frustration, and dissatisfaction. Math anxiety is also often referred to as the discomfort a person may feel when asked to perform math-related activities Maloney & Retanal, (2020) or feelings of stress, feelings of inability, and difficulties unexpected thoughts to manipulate numbers and shapes. According to Kaskens et al., (2020) mathematics anxiety is defined as an expression of worry about situations involving mathematics as a threat to self-confidence. If a person's self-confidence level is high, then their anxiety can be controlled. Mathematics study habits refer to something that can be learned, consistent and effective study methods and habits (such as the willingness to practice past exam questions and work on popular mathematics problems) (Lindsay & Evans, 2022). Preparing students is not only about acquiring certain aspects of mathematics but also about studying theorems, rules, and definitions carefully and working on mathematical tasks in a focused manner (Álvarez et al., 2020).

3. Method

3.1. Research Design

This research uses quantitative methods with a survey approach (Baas et al., 2020). The survey was carried out by compiling instruments according to research indicators. The OPM learning instrument is used to measure student behavior related to other aspects of mathematics achievement. In this research, only three variables were used, namely the attitude variable in learning mathematics, the doubt variable in learning mathematics, and the behavioral variable in learning mathematics. This research instrument is based on the OPM research questions of the study (Hill et al., 2020). The number of instruments for each inductor element of the three OPM variables is shown in Table 3.

Table 3: OPM Research Questions (Hill et al., 2020)

Number	OPM Change Tool	Number. items
1.	Attitudes in the study of mathematics	19
2.	Worried about studying math	16
3.	The habit of studying mathematics	16
	Amount	51

3.2. Respondent

The subjects in this research were elementary school students. The population in this study were all fourth-grade elementary school students from five different schools. Where each school has two classes, for students who are in fourth grade. The total population of the five schools is 650.

Meanwhile, the sample in this study was 251 people. Samples were chosen randomly without paying attention to the order. Samples were selected from five schools with the same number of students.

3.3. Data Collection

The data collection procedure in this research is by survey. The instrument was prepared based on OPM mathematics learning research indicators. OPM data was obtained from fourth-grade elementary school students who were collected in special classrooms. Students receive information regarding research questions that are circulating and then collected by the researchers themselves. Meanwhile, information on the results of the mid-semester exams in the mathematics subject, addition material, was collected from 2018 to 2022, obtained from teachers through efforts to collect exam results for each school which are still stored in the mathematics teacher summary data. Meanwhile, the questions in this research instrument use a Likert scale with four choices. Choice 1 (very wrong), choice 2 (not true), choice 3 (true), and choice 4 (very true). The OPM measurement instrument consists of three variables with a total of 51 items. Meanwhile, the mathematics passing score is based on the minimum completeness criteria set by the teacher in mathematics lessons, namely a score of 70.

3.4. Data Analysis

This research analyzes data using the Statistical Package for Social Science (SPSS) version 26 Okagbue et al., (2021) software by looking at the average, t-test, standard deviation, and quartiles and looking at the significance of the results of the data that has been collected. In addition, the data that has been collected was analyzed with descriptive statistics using SPSS version 26 with remeasurement, Pearson correlation, and simple regression tests.

3.5. Validity

From the validation test of this research instrument, it was discovered that 251 random students found it easy to answer the questions. Students who answered easily consisted of 160 men (63.7%) and 91 women (36.3%). Based on the validation test, the instrument used to measure OPM mathematics learning is valid and appropriate.

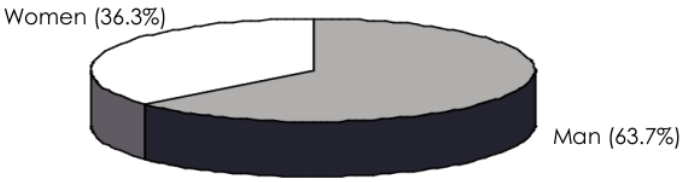

Figure 1. Students ' profiles by gender

4. Findings

This research found a relationship between attitude modifiers, doubts and habits.

Table 4. Min, standard analysis, and Pearson correlation can change attitudes, doubts, and habits

Change activation tool		Min.	Skillful apart	1	2	3	4
1	Attitude	55.13	6.01	1h00	–.41**	.68**	.19**
2	Anxiety	42.22	6.78		1h00	–.46**	–.31**
3	Habits	42.82	5.78			1h00	.20**
4	Realization	6:57 p.m.	2:38 p.m.				1h00

p< 0.01 (2-sided)

Table 4 above shows the relationship between attitude modifiers, doubts, and habits. The relationship between attitude and doubt is a significant negative relationship ($p < 0.01$). This means that the higher the attitude towards learning mathematics, the lower the level of doubt

in studying mathematics; conversely, the lower the attitude, the higher the level of doubt. The relationship between attitude and simple doubt is –0.41. At the same time, the relationship between attitudes and habits is also positive and significant ($p < 0.01$). This shows that the higher the attitude in learning mathematics, the higher the behavior in learning mathematics, and conversely, the lower the attitude in learning mathematics, the lower the attitude in learning mathematics. Weak mathematics learning. The relationship between mathematics learning attitudes and mathematics learning behavior has a high correlation value, namely 0.68. The relationship between hesitation and behavior is negative and significant ($p < 0.01$). This shows that the higher the level of doubt in studying mathematics, the lower the behavior in studying mathematics and vice versa. The relationship between doubts about learning simple mathematics and attitudes towards learning mathematics is –0.46.

Table 5. Multiple regression analysis can change attitudes, doubts, and habits in favor of additional mathematics achievement.

Lean Modifier (Success)					
Change activation tool		Additional Student Mathematics Achievement Score			
Not to bend over	Beta no qualified	No mistake qualified	Beta qualified	t-statistics	Sig.
Forager	31.87	13.07		2.44	.02
Habits	.11	.21	.05	.53	.60
Anxiety	–.58	.15	–.27	–3.94	.00*
Attitude	.11	.20	.05	.56	.57
F-value			9.36		.00*

*****$p<0.05$

Multiple regression analysis was carried out to see the contribution of changing attitudes, doubts, and habits in studying mathematics to students' incremental achievement in mathematics. Table 5 shows the results of a multiple regression analysis with additional mathematics achievement variables. The regression model has a simple R2 determinant coefficient of 0.10 with an adjusted R2 of 0.09. This shows that an additional 9% of the variance in mathematics achievement can be jointly explained by the three variables, namely attitudes, doubts, and habits in studying mathematics. The statistical results show that the F value of 9.36 is significant ($p < 0.05$) for this regression model. This means that at least one regression coefficient in each regression model is significantly different from zero. The t-statistics tests revealed that the regression model had only one independent variable, namely doubt significant ($p < 0.05$), while attitude and behavior were not significant ($p > 0.05$) with the student's additional math results. The results of this study show that hesitation to study mathematics is the main contributor, or 10%, to additional mathematics achievement. According to Table 5, the appropriate regression equation model to use to predict incremental mathematics achievement is: Additional math achievement = 31.87 + 0.11 (attitude) – 0.58 (anxiety) + 0.11 (character) + e (0.56) *(–3.94) (0.53). *****$p< 0.05$, R2 = 10%. In mathematics learning, OPM modifiers are effective modifiers that are very important in realizing students' willingness to participate in mathematics learning, directly or indirectly.

5. Discussion

The relationship between possible changes in attitudes, concerns, and habits and additional mathematical outcomes. The results of the study show that the three variables of OPM, namely attitude, doubt, and behavior, have a significant positive and negative relationship with additional mathematics achievement. First, the possibility of changing attitude in the study of mathematics has a positive correlation and is found to be significant with additional mathematics achievement. The importance and role of attitudes in the study of mathematics influencing achievement are consistent with the studies of Mamin et al., (2020); Veas et al., (2019); Zhang & Wang, (2020); Habók et al., (2020) who state that students who have a low attitude in studying mathematics are associated with low achievement, while students who have a high attitude in learning mathematics perform well and perform well in mathematics. Attitude has a relationship with learning motivation which leads to increased achievement. This

is consistent with Primi et al., (2020) study that students who have a positive attitude are highly motivated to learn and perform well. In this study, attitude was the second most influential variable in incremental mathematics achievement. The mathematics study anxiety variable showed a negative correlation and was found to be significant for achievement. High math doubt is associated with low math achievement, while low math doubt indicates high math achievement. The results of this study are consistent with the studies of (Baas et al., 2020; Zhu & Liu, 2020; Robinson et al., 2021). A meta-analysis conducted by Zhang & Wang, (2020) also suggests that there is a negative relationship between mathematics anxiety and mathematics achievement. These results are consistent with studies by Hidayati et al., (2020) according to which students who have doubts about mathematics feel less comfortable and feel pressured to carry out mathematics activities. Calculation and solving mathematical problems, particularly in the manipulation of numbers and shapes. The ability to change behavior when studying mathematics showed a positive correlation and was found to be significant in improving mathematics achievement. This result is consistent with the results of Zhou et al., (2020) who showed that the habit of studying mathematics has a significant positive relationship with mathematics achievement. This coincides with (Blaabæk, (2020) deficit model, which states that students' low achievement in mathematics is due to poor study habits and a lack of skills in doing mathematics exercises and tests. According to (Zanden et al., 2020; Thomson et al., 2020), factors such as attitudes, doubts, and mathematics learning habits play a very important role in students' effective mathematics learning and can indirectly improve their mathematical understanding and achievement. The focus on learning is important so that students are emotionally ready before participating in mathematics learning. Students' emotional willingness is important so that the mathematics learning they participate in is memorable and they understand what is being learned. This can indirectly help students improve their level of achievement in mathematics in any test or exam. Ryan & Deci, (2020) states that a student's willingness to learn can lead to satisfaction with learning and subsequent mastery. This desire to learn mathematics encourages students to perform mathematical activities more effectively.

Largest contributor to additional mathematical achievements/multiple regression analysis of the three OPM variables, namely attitudes, doubts, and habits controlled collectively. The results of the analysis of each variable show that the probability of changing anxiety is the highest, namely 9.30% in explaining the variance of additional mathematical achievement, followed by the probability of changing behavior (3.70 %) and the probability of changing attitude (3.10%). This means that anxiety is the main contributor or predictor of further mathematical achievement. The regression analysis for the three variables shows that 9% (adjusted R2 = 0.09) of the variance in mathematics achievement further comes from the variables of attitude, doubt, and mathematics learning habits. This means that 91% of the variance in results is due to other factors. The results of the analysis also revealed that only the anxiety variable was significant for achievement with a value of t = –3.94. This suggests that anxiety contributes greatly to incremental mathematical achievement. However, changing attitudes and habits always contributes to success, even in a small way. Thus, the multiple regression model for additional mathematics achievement is –3.94 (undecided). The results of this study are consistent with the studies of (Xie et al., 2020), where indecision showed a negative relationship with mathematics achievement. Students who have a high level of uncertainty in learning mathematics show low achievement, while students who have a low level of doubt show high achievement.

The results of this research imply that mathematics teachers must be sensitive and pay serious attention to affective skills before carrying out additional mathematics teaching aimed at improving students' mathematics achievement. Teachers who teach additional mathematics should try to improve OPM, especially students' attitudes towards additional mathematics. Students who have a positive attitude in learning mathematics show good study habits.

6. Conclusion

A study among fourth-grade technical students in technical secondary schools in Kelantan State showed that there was a significant positive or negative relationship between changes in mathematics learning, namely attitudes, doubts, and habits of learning mathematics, towards additional achievements in mathematics. The ability to change attitudes and habits shows a positive relationship with achievement, while indecision shows a negative relationship with achievement. Multiple regression analysis showed that indecision was the main factor contributing to improved mathematical achievement. With this, it can be formulated that the orientation of learning mathematics is one of the factors that play a very important role in determining the level of further achievement in mathematics of students, whether they are brilliant, satisfactory, or failed.

Limitation

The weakness of this research is that it does not use more effective variables. Therefore, this research suggests the use of more affective variables such as teacher motivation, learning environment, and teaching approaches as well as students' socio-economic status to provide a complete picture. Another weakness is that the population and sample are too small. The population and sample studied should be expanded to include all technical secondary school students in Indonesia. Another weakness is the lack of studies on gender, this research also suggests that more study questions include gender, nationality, school location, school level, fraction of additional mathematics components, and aspects of additional mathematics teaching.

Recommendation

Here are some suggestions teachers should 1) Create an environment where students feel comfortable and do not feel threatened; 2) Use cooperative learning strategies. This helps students understand any problems and solve them together; 3) Teach slowly. This can help students fully understand what is being taught, and 4) Organizing additional learning sessions to increase learning understanding. All these positive efforts can reduce levels of mathematical uncertainty and subsequently improve student performance and outcomes. Teachers must also try to reduce the level of students' doubts about mathematics. To create students who have positive attitudes and habits and a low level of doubt about learning mathematics to improve their achievement, teachers must design effective teaching and learning strategies that can encourage students to develop concepts and master skills while applying them in everyday life.

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Conflict of Interest

There are no conflicts of interest between fellow authors and there are no conflicts of interest between the authors and the public in the research and publication of the results of this research.

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