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FACTORS INFLUENCING MATHEMATICAL PROBLEM-SOLVING COMPETENCY: A CASE STUDY ON HIGH SCHOOL STUDENTS

Paisan MALANGTUPTHONG[1], Wasutida NURITTAMONT[2] and Bordin PHAYAPHROM[3]

1 European International University, France; paisan7481@gmail.com
2 Rajamongkala University of Technology Suvarnaphumi, Thailand; wasutida.n@rmutsb.ac.th
3 Asia eLearning Management Center, Singapore; alex@aemcenter.school

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Abstract

This research aims to explore factors that affect mathematics problem-solving student characteristics competency in high school. A conceptual framework was developed utilizing quantitative study methodologies to generate research hypotheses, which included studies on the effects of teacher, attitude towards mathematics, and achievement motivation on students' ability to solve mathematical problems. The population was high school students who are studying at the academic year 2021 Science and Mathematics program for 20,948 students under the secondary educational service area office Samut Sakhon and Samut Songkhram. Multi-stage sampling was used to select 400 high school students in Samut Sakhon and Samut Songkhram Province from the first semester of the academic year 2021. This research used an online questionnaire to collect the data for this investigation. Partial Lease Square Structural Equation Modeling (PLS-SEM) was used for data analysis. The analysis was carried out by the research using the ADANCO program. The study found that the factor positive affected on mathematical problem-solving competency are Teacher teaching and attitude towards mathematics. the factors with a positive impact on attitude towards mathematics are achievement motivation and Teacher teaching. the factors with a positive impact on achievement motivation is only Teacher teaching. However, achievement motivation does not positively affect the mathematical problem-solving competency.

Keywords: Mathematical Problem-Solving Competency, Teacher Teaching, Mathematics Achievement Motivation, Attitude Towards Mathematics

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Introduction

To develop human intelligence, mathematics is very essential. Mathematics assists individuals with predicting, preparing, determining, solving mathematical problems, evaluate different situations or conditions, and apply mathematics in daily life. Furthermore, mathematics is essential for studying science, technology, and other disciplines. Therefore, in improving human intelligence mathematics plays a very significant role (Ministry of Education, 2008). Learning standards and indicators of mathematical learning paradigm (Revised version 2017) according to the core curriculum of the Basic Education of Buddhism, 2008, this issue was made with thought to have the skills that are fundamental for mastering in the 21st century, and that prepares students thinking, analysis and solving numerical issues skills. A key ability needed by the present students is critical thinking. Driven by recent guidelines problem resolution study; changing professional standards, modern workplace demands, recent developments in the philosophy of learning, educators and trainers are to provide integrated learning environments that allow curricula to be updated, and higher-order thinking skills and, in particular, problem-solving skills are used by learners abilities (Kirkley, 2003) Concluded, to accomplish the aim of teaching mathematics in classrooms, students must be able to solve mathematical problems. The knowledge of mathematical problem-solving skills will be the foundation to develop the methods of thought and improve the problem-solving abilities of students in daily life.

The research of many professors has shown using a problem-solving approach to teaching and learning mathematics is valuable for all students. So, the significance of the problem-solving approach doesn't waste time. Teaching through problem-solving will boost rational reasoning, allowing individuals to determine what rule a situation needs basing on its aesthetic form since teaching mathematics by problem-solving strategy is valuable. Teaching by problem-solving helps the student to feel several emotions associated with different stages of the solution process. Mathematicians who solve problems effectively claim that the practice of doing it leads to understanding the force and beauty of mathematics. Furthermore, Problem-solving supports and motivates students to learn fundamental facts and algorithms. One of the most critical aspects of mathematics teaching is inspiring students to be enthusiastically interested (Atsu, 2015), successful educators should reflect on individual differences and strive to build on them. The aims of the Basic Education Core Curriculum of 2008 (revised version 2017) have started focusing on the importance of learning mathematics and the quality of the learners. But nowadays, it is found that mathematics teaching has not achieved the objectives of the curriculum. The Ordinary National Education Test (O-NET) academic performance evaluation found that in 2015. 423,654 students participated in the national test with an average score of 26.59 out of 100, in 2016. 379,064 students participated in the national test and the average score was 24.88 out of 100 points, in 2017. And 372,853 students participated and the average score was 24.53 out of 100. These data show that each year students are taking the test and unluckily the average grade of disqualification are getting dropped every year. Considering the score of 2018, the students had an average score of 31.04, and in 2019, the mean score was 25.62, the average score was 5.42 lower when looking at the average score in 2020, the student's score was also below the established criteria. Besides, the mathematical aptitude test (Professional and Academic Aptitude Test) found that in 2017 the average score was 49.61 out of 300, in 2018 the average score was 48.45 out of 300 points, in 2016 and 2019 has an average score of 49.05 out of 300 and when looking at the average score in 2020, the student's score was also below the established criteria (National Institute of Educational Testing Service, 2017). Each year students who pass the test have an average score that does not meet the criteria and tends to decrease And it demonstrates the ability to ask students to solve math problems dwindling (Natchaphon B., 2019). This could be caused by many factors. Since skill is necessary for future learning, therefore, developing the ability to solve mathematical problems

of students is an important task for teachers to develop students' ability to solve mathematical problems. As educators and psychologists have examined and presented differently, how well a learner can answer a mathematical issue is dependent on a range of elements. Educators found that Bloom's theory and McClelland's theory support the teaching and learning of students to solve mathematical problems and improve academic achievement. Bloom's theory of learning concluded that the influencing factors of level of academic achievement consisted of three factors: the first factor relates to the learners' background knowledge and aptitude. It is a factor that relates the attitude towards the content of the subjects studied in school as well as the learning system, interests, motivation, self-ability acceptance, and Self-esteem. The third factor is the teaching quality. Participation in educational activities supports students by teachers and allows them to learn the results that they can act properly. Besides, according to Bloom's Taxonomy, these three factors influence student's level of academic achievement. Bloom et al. (1956) also concluded a factor named family environment, which is a factor that effects on learning of learners, including the attitude of their parent's parental support for student education.

McClelland's theory of Achievement Motivation emphasizes, achievement motivation is significant for students, it's because achievement motivation is the most important for official success. In other words, students who are highly motivated and accomplished will concentrate on studying and eventually get success, on the other hand, students with low achievement motivation get a lack of study interest and eventually get fail (Pimta et al., 2009) that motivation for achievement is a kind of motivation that encourages students to have a positive attitude towards their studies until getting success. In other words, those who perceive their abilities and set high goals are more motivated to act and perform better than those who doubt their abilities. Furthermore, people who assess themselves get abilities to be successful at high activity (Charoenchim, 2010).According to the mentioned learning theory, it can be predicted that factors influencing students' academic achievement consist of several learning aptitude studies; intention, attention, attitude towards the subjects studied achievement motivation learning behavior teaching behavior of teachers. Parental expectations support of parents results in students learning and developing learning in different levels. When students learn well, it will result in them getting good academic achievement. The study of various learning theories and the problems of mathematics teaching management found that the study of factors that influence the ability of students to solve mathematical problems is meaningful because knowing the factors that promote or hinder the development of students' ability to solve mathematical problems assist teachers to use it as information for effective learning activities and developing students skills and abilities. Therefore, this research aim is to study factors that influence mathematical problem-solving competency by using structural equation modeling analysis. The knowledge of this study will convey significant information to teachers to develop students' skills. In addition, the administrators who are involved in the management of education as a guideline to organize the teaching and learning activities to indorse students for having better mathematical problem-solving skills and abilities.

Literature Review

Mathematics Problem-Solving Competency

Problem solving is not only a goal but also a major means of learning mathematics. It is an essential part of the mathematics program, not a separate component. Students need numerous opportunities to develop, wrestle with, and solve complex problems that require a lot of work. They should be taught to reflect on their thoughts while solving problems so that they can apply and adapt the tactics they create to different problems and situations. Students develop ways of thinking, habits of tenacity and curiosity, and confidence in unusual situations by solving mathematical problems. These skills will serve them well outside of the mathematics

classroom. (National Council of Teachers of Mathematics, 1906). Problem-solving and Bloom's Taxonomy are related and problem-posing has become important cognitive activities in teaching and learning mathematics. Many researchers argued that the traditional way of assessment cannot truly reveal what the students learned and knew. The authentic assessment was utilized to measure the pupils' mathematics learning as an alternate way. Students' ability to solve and pose mathematical problems can be assessed using a performance rubric. Teaching and learning mathematics has centered on problem-solving activities that are viewed as a goal, a process, and a skill for the past few decades. (Rosli et al., 2013). Students frequently reflect on the mathematical ideas in problem-solving activities, producing ideas that are more likely to be absorbed with prior knowledge during the activities. (Walle et al., 2014). Students will be actively engaged in all NTCM process standards: problem-solving, reasoning, communication, connections, and representation while creating and restructuring their knowledge while solving worthwhile challenges. When problem-solving is applied effectively in the classroom, students' mathematical power is finally developed, according to the Principles and Standards statement. (National Council of Teachers of Mathematics, 2000).

According to Felmer et al. (2016), Problem-posing is an important component of problem-solving since it can happen before, during, or after a learner completes a mathematical job. Problem-posing encompasses both the creation of new problems based on a context and the reformulation of existing problems into new ones. Students develop and acquire mathematical ideas while exploring their curiosity within specific situations as they creatively pose new issues, similar to the problem-solving process. (Rosli et al., 2013). According to research, problem-posing is increasingly being used in classroom activities to help pupils understand math. It is currently a significant part of mathematics instruction and learning. As a result, problem-posing is included in the reform vision for fostering mathematics as a cognitive activity, alongside problem-solving. (National Council of Teachers of Mathematics, 2000). Indeed, the Principles and Standards document states, “Good problem solvers tend to naturally pose problems based on situations they see”, Rosli et al. (2013) claimed that astonishing efforts have emerged in the usage of authentic assessment for examining; not only the product and the skill of problem-solving and problem-posing, but also the process when a student is doing the task. Schoenfeld’s problem-solving theory, in the solution of mathematical problems, there are stages: Analysis of the problem, selection of appropriate mathematical knowledge, planning implements the plan, and check the answer (Harskamp & Suhre, 2007). Problem-solving emerges as one of the most important skills that an individual should have. In this context, it is thought that reflective thinking can contribute to the problem-solving process. Based on the fact that reflective thinking occurs only when a certain problem is perceived (Schargel & Smink, 2013), it can be said that reflection can best be observed in the problem-solving process. This study aims to improve students' reflective thinking skills towards problem-solving. It is the development of a scale to be used in determining (Kizilkaya & Aşkar, 2009).

When it comes to measuring a skill, the actions that bring about that skill need to be examined. In this context, one of the actions that show the reflective thinking skill one seems to be questioning (McLeod et al., 2015). Inquiry in its simplest definition It is the process of seeking answers to the questions produced by the person or directed to him from the outside. Reflective Another of the actions taken in the thinking process is evaluation. Evaluation while developing a scale, the concept of “Looking back on the action of the person, analyzing It has been defined as determining the wrong and the right. Reflective in the problem-solving process Another dimension of thinking is determined as reasoning. Reasoning, scale According to the conclusion reached by looking to investigate the reason for the actions taken by the person It has been defined as the study of cause-effect relationships. In this study, for problem-solving reflective thinking has been developed within these three dimensions. 1) Questioning 2) Evaluation 3) Reasoning (Kizilkaya & Aşkar, 2009; McLeod et al., 2015; Lee, 2005).

Teacher teaching influence on Attitude Towards Mathematics, Achievement Motivation, and Mathematical Problem-Solving Competency

Mathematics Learning Environments and Attitudes. Akey (2006) work showed that several aspects of school context (e.g., teacher support, student-to-student interaction, and the academic and behavior expectations of the teacher) were significantly related to student attitudes and behaviors. Akey (2006) concluded that the class environment where teachers who students see as supportive promote student feelings of control and confidence in their ability to succeed. The way students perceive Teacher teaching will affect their attitudes towards mathematics (Soni & Kumari, 2015). Maat & Zakaria (2010) identified a significant relationship between learning environment and attitude towards mathematics. Students with a higher perception of the learning environment and a more positive perception of their teachers have more positive attitudes towards mathematics (Maat & Zakaria, 2010). Mata et al. (2012) also found that students had a more positive attitude towards mathematics when their teacher was perceived to be highly supportive. In addition, the teachers strongly influence pupils' attitudes towards mathematics. Marchis (2011) and teacher's factor showed that the correlation between learning environment and attitude towards mathematics was significantly (Maat & Zakaria, 2010). Teachers have an important role in enhancing their students' motivational levels. A student may arrive at the class with a certain degree of motivation, but the teacher's behavior, teaching style, and the kind of interaction with the students all have a large effect in determining the teacher's role in developing the students' motivation. As it has been noticed by the researcher there is a huge variation in the levels of motivation among the students. The effectiveness of the teacher, friends, the individual's attitude toward school, students' perceptions about their abilities, past experiences (positive or negative), the importance placed on the student's success, and parent's approaches to their children and school are all factors that affect students' achievement motivation. (Aydın & Coşkun, 2011). The result of the research show that achievement motivation have a significant effect on the effective teacher (Renata et al., 2018). Moreover, teacher-student and parent-child relationships are significantly associated with achievement motivation (Hanna & Dempster, 2009) and teacher-student relationships contribute to students' increased level of motivation to learn as well as enhanced their academic achievement (Yunus et al., 2011).

By having an indirect effect through accomplishment desire and attitude toward the subject, teacher behavior had both direct and indirect effects on students' problem-solving skills. The teacher's actions had a favorable effect on students' problem-solving abilities at the 0.01 level of significance in this study. The educational tools were appropriate for the students since the instructor had managed the class with diverse activities; additionally, the teacher knew about the psychology of teaching to meet each student's needs, and the teacher's assessment or evaluation met the curriculum's purpose. Their ability to solve problems was directly influenced by the teacher's conduct. (Pimta et al., 2009) and extent children's development of arithmetic fluency and mathematical problem solving was influenced by their math self-concept, math self-efficacy, and math anxiety but also a teacher competence (Kaskens et al., 2020).

H1: Teacher teaching positive significant influence on attitude of toward mathematics.

H2: Teacher teaching positive significant influence on achievement motivation

H3: Teacher teaching positive significant influence on mathematical problem-solving competency

Achievement Motivation influence on Attitude Towards Mathematics and Mathematical Problem-Solving Competency

By going via the learners' concentration and attitude towards mathematics, achievement desire was a direct factor impacting students' problem-solving skills. (Pimta et al., 2009). Results indicated a positive significant correlation between students' attitude towards learning and

achievement motivation and between students' attitude and academic achievement (Bakar et al., 2010). A hierarchical analysis using structural equation modeling showed that motivation related variables are the main predictors of attitudes towards mathematics and that teachers and the social support of peers are also highly significant in understanding these attitudes (Mata et al., 2012). By going via the learners' concentration and attitude toward mathematics, achievement desire was a direct factor impacting students' problem-solving skills. According to the findings, pupils' problem-solving skills improved when they had an accomplishment motive. This was due to the students' motivation to do all they could to ensure that their successors outperformed everyone else. As a result, if students have an achievement motive to answer mathematic issues well, they will have a positive attitude toward the topic; also, students will have better concentration and pay attention in class, resulting in strong mathematic problem-solving skills (Pimta et al., 2009). the achievement motivation moderated relationship of learning approaches and academic achievement significantly (Bakhtiarvand et al., 2011) and there was a statistically positive significant correlation between achievement motivation and educational achievement (Fini & Yousefzadeh, 2011).

H4: Achievement motivation positive significant influence on attitude of toward mathematics

H5: Achievement motivation positive significant influence on mathematical problem-solving competency

Attitude Towards Mathematics influence on Mathematical Problem-Solving Competency

By moving through focus in classes, students' attitudes about mathematics have both direct and indirect effects on their mathematical problem solving. The reason why the students' attitude toward the subject had a positive effect on their problem solving was that the students had a positive attitude toward mathematics and realized how important it was to learn to apply the knowledge in everyday life. As a result, the students loved and enjoyed learning, they also concentrated on their problem solving, and they were able to improve themselves as a result. (Pimta et al., 2009) and mathematics attitudes contributed to students' mathematics performance over and above personality and cognitive ability (Lipnevich et al., 2016). Moreover, Results indicated a positive significant correlation between students' attitude towards learning and achievement motivation and between students' attitude and academic achievement (Bakar et al., 2010).

H6: Attitude towards mathematics positive significant influence on mathematical problem-solving competency

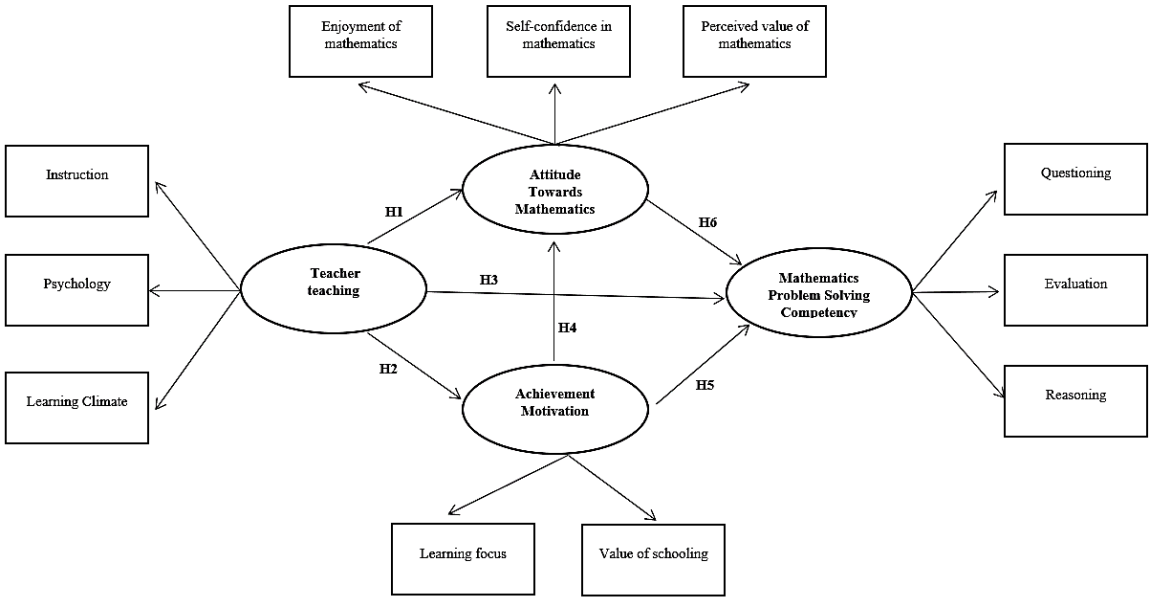

Figure 2 Conceptual Framework

Research Methodology

The researcher used an online method to collect the data for this investigation. The data were gathered from 400 students in 10 Samut Sakhon and Samut Songkhram high schools who are enrolled in the Science and Mathematics curriculum and have a GPA of 3 or higher under the Educational Service Area Office Samut Sakhon Samut Songkhram, Office of the Basic Education Commission Ministry of Education, between September and October 2021. The Attitude of Towards Mathematics Questionnaire, the Achievement Motivation Questionnaire, Teacher teaching Questionnaire, and the Mathematical Problem-Solving Competency Questionnaire were used to collect data for this study. The operational construct was adapted from previous research. Multi-item measurements were taken using a five Likert scale ranging from "strongly disagree" (1) and "strongly agree" (5) (Nurittamont, 2021; Ekchamnong et al., 2021). The data was evaluated after the researcher gathered the questionnaires to determine the factors that influence Mathematical Problem-Solving Competency. For the structural equations, this study used the Structural Equation Modelling (SEM) approach with ADANCO version 2.1.1. (Henseler, 2017). For the test of hypothesis, ADANCO employs a composite-variance based modeling approach that does not require the data to be normal (Hulland, 1999). Partial least squares path modelling (also known as PLS modelling, PLS-SEM, or just PLS) and ordinary least squares regression based on sum scores are two limited-information estimators implemented by ADANCO (Henseler, 2014). This data analysis looks at Measurement Model and Structural Model follow by Panya et al. (2022) and Jatiyananda et al. (2021).

To test the validity of the measurement model, the authors utilized Goodness of Model Fits (GoF), the SRMR, d_{ULS} and d_G statistics of the saturated model showed that the SRMR (HI95 = 0.022; HI99 = 0.0258) was less than d_{ULS} (HI95 = 0.0342; HI99 = 0.0438) and d_G (HI95 = 0.0405; HI99. The estimated SRMR (HI95 = 0.022; HI99 = 0.0258) was found to be less than d_{ULS} (HI95 = 0.0342; HI99 = 0.0438) and d_G (HI95 = 0.0405; HI99 = 0.0501), indicating that the models in this study were of good quality and in good quality. As a result, the dataset's measurement model is adequate. Finally, Figure 1 shows the dataset model's structural Equation model outcomes. Cronbach's alpha is used for reliability analysis, and

values ranged from 0.8224 to 0.9419 above the cutoff point 0.70, which is considered acceptable (Hair et al., 2011).

Research Results

Demographic Analysis

This research is aimed at exploring factors that affect mathematics problem-solving student competency in high school. The population is high school students who study in the academic year 2021 Science and Mathematics program for 20,948 students under the secondary educational service area office Samut Sakhon Samut Songkhram. Multi-stage sampling was used to select 400 high school students in Samut Sakhon and Samut Songkhram Province from the first semester of the academic year 2021. The researcher used an online method to collect the data for this investigation. The data will be gathered from 400 students in 10 Samut Sakhon Samut Songkhram high schools who are enrolled in the Science and Mathematics curriculum and have a GPA of 3 or higher., under the Educational Service Area Office Samut Sakhon Samut Songkhram, Office of the Basic Education Commission Ministry of Education, between September and October 2021. The general demographic of the respondents (n = 400) was mostly female (73.75%), 188 students (47%) were Grade10 students and 119 students were Grade11 (29%). In addition, 23.30% of the respondents were 93 Grade12 students. The Attitude of Toward Mathematics Questionnaire, the Achievement Motivation Questionnaire, Teacher teaching Questionnaire, and the Mathematical Problem-Solving Competency Questionnaire was used to collect data for this study. The data was evaluated after the researcher gathered the questionnaires to determine the factors that influence Mathematical Problem-Solving Competency. The PLS-SEM data analysis approach was used to evaluate the association between observable variables and latent reflective variables in this study. The analysis was carried out by the researcher using the ADANCO application.

Model Measurement and Thresholds

For the structural equations, this study used the Structural Equation Modelling (SEM) approach with ADANCO version 2.1.1. (Henseler, 2017) to test the hypothesis, ADANCO employs a composite-variance based modelling approach that does not require the data to be expected (Hulland, 1999). Partial least squares path modelling (also known as PLS modelling, PLS-SEM, or just PLS) and ordinary least squares regression based on sum scores are two limited-information estimators implemented by ADANCO (Henseler, 2014).

Reflective constructs are the correlations between latent variables and observable variables. A two-step analysis was carried out. The first step is for the researcher to examine the structural model's quality, including determining the constructs' reliability and validity (Sekaran & Bougie, 2016). The next stage was determining the model fit, route analysis, and calculating the parameters. As a result, appropriate statistics levels are determined to measure the model, as shown in table 1.

Table 1 Structural Equation Modelling measurement and acceptable thresholds

Measurement	Indicator	Acceptable Thresholds
Construct reliability	Cronbach's Alpha	0.6 to 0.70 is acceptable (Hair et al., 2011) > 0.70 is enough for research (Nunnally et al., 1967)
	Indicator reliability	> 0.70 and significant at least 0.05 level (Hair et al., 2011)
	Composite reliability	Jöreskog's rho (ρc), Dijkstra-Henseler's rho (ρA) must be more than 0.7 (Henseler, 2017; Werts et al., 1974)
Convergent Validity	Average Variance Extracted (AVE)	> 0.50 (Bagozzi & Yi, 1988; Thompson et al., 1994)
Discriminant Validity	Fornell and Larcker, Heterotrait-Monotrait Ratio of Correlation (HTMT)	The square root of the AVE of a construct should be more than the correlations between the construct and other constructs (Fornell & Larcker, 1981).
Fit Index	Goodness of model fit GoF (SRMR)	< 0.08 (Hu & Bentler, 1999)
Model Validity	Structural Equation Modelling (SEM)	t-value for a two-tailed test are 1.65 (sig = 0.1), 1.96 (sig=0.05) and 2.58 (sig=0.01) (Meinshausen & Rice, 2006)

Construct Reliability

Model reliability indicates the construct's internal consistency. Cronbach's Alpha was used to assess internal consistency. A minimum of 0.7 is required to show (Hair et al., 2011) Jöreskog's rho (ρc), used as the composite reliability indicators. It also regards the construct's reliability, and the composite reliability values greater than 0.7 are accepted as the indicator of reliability and homogenous construct (Henseler, 2017). Dijkstra & Henseler (2015) claimed that their rho (ρA) is the most reliable test for consistent reliability with a minimum score of 0.7. Table 2 below shows that all three components values are more significant than 0.7, which is considered an acceptable internal consistency.

Convergent Validity

The variable indicators can be evaluated using convergent validity. Convergent validity refers to a measure's ability to correlate favorably with other measures of a related construct. Multiple techniques to measure the same construct are thought of as reflective construct indicators. In this sense, the items that are indicators or measures of a particular reflective construct should integrate or share a significant degree of variation. To determine the convergent validity of reflective constructs, the researcher looks at the external loadings of indicators and the Average Variance Extracted (AVE).

Fornell & Larcker (1981) suggested that the minimum cut of value for each latent construct's Average Variance Extracted (AVE) should be 0.50, Remove all items with a loading time of less than 0.50. (Hair et al., 2016) Therefore, the findings of this study supported the latent constructs' high dependability. All AVE scores are more significant than 0.50, and item loadings of other internal consistency indicators provided in table 2 are more significant than 0.60, confirming the constructs' good internal consistency.

Table 2 Overall Construct Reliability Loading and Convergent Validity

Latent variables and observable variables	**Item Loading**	**AVE**	**Dikstra-Henseler's rho (ρ_A)**	**Jöreskog's rho (ρ_C)**	**Cronbach's Alpha ($\propto$)**
Achievement Motivation		0.8915	0.9438	0.9426	0.9419
Value of schooling	0.9191				
Learning focus	0.9686				
Attitude Towards Mathematics		0.6085	0.8289	0.8226	0.8224
Enjoyment	0.7415				
Self-confidence	0.7305				
Perceived value	0.8614				
Mathematical problem-solving competency		0.6492	0.8483	0.8473	0.8474
Questioning	0.7852				
Reasoning	0.7913				
Evaluation	0.8396				
Teacher teaching		0.8872	0.8872	0.8852	0.8860
Instruction	0.8875				
Learning Climate	0.8554				
Psychology	0.8007				

Discriminant Validity

The degree of discrimination between variables is represented by discriminating validity values. By comparing the measured value for each factor to other constructs, ADANCO assesses the biased significance. The square root of the AVE value should be greater than the AVE value of the other variable. (Fornell & Larcker, 1981). Table 3 shows the discriminatory validity tests' consequences and shows that discriminatory validity is appropriate. Both diagonal values outperform inter-constructed correlations, indicating that selective validity is acceptable. As a result, it is reasonable to assume that the measurements have acceptable construct validity

Table 3 Discriminant Validity

Construct	**Achievement Motivation**	**Attitude Towards Mathematics**	**mathematics problem-solving competency**	**Teacher teaching**
Achievement Motivation	0.8915			
Attitude Towards Mathematics	0.6052	0.6085		
mathematical problem-solving competency	0.4443	0.5914	0.6492	
Teacher teaching	0.4157	0.3413	0.5613	0.7202

Squared correlations; AVE in the diagonal

Descriptive Analysis

In this study, the descriptive analysis indicated that the items "You have the goal of studying mathematics to be able to apply your knowledge to university entrance exams." ($\bar{x}$ = 3.97, S.D. = 0.60) from achievement motivation has the higher mean value. And this research found that the item "You are satisfied when you gain experience and knowledge in solving math problems" ($\bar{x}$ = 3.71, S.D. = 0.67) has the lowest mean value, compare to other items and the

overall mean value of this construct. Attitude towards mathematics showed that the items "you think math is one of the important subjects for students going to university" ($\bar{x}$ = 4.16, S.D. = 0.51). has a higher mean value. Also, the item is "You are confident that you can learn mathematical content." ($\bar{x}$ = 3.42, S.D. = 0.68) has the lowest mean value, compared to other items and the overall mean value of this construct. Moreover, mathematical problem-solving competency showed that the items "When you solve math problems you are always looking for the most suitable method to solve the problem." ($\bar{x}$ = 4.02, S.D. = 0.58) have the higher mean value. Also, the item is "When you solve math problems. you will think about the purpose of taking each step of the solution." ($\bar{x}$ = 3.88, S.D. = 0.63) has the lowest mean value, compared to other items and the overall mean value of this construct. Finally, Teacher teaching showed that the items "The fact that teachers have to access to all students thoroughly. Makes you take care of affecting the efficiency of learning mathematics as well." ($\bar{x}$ = 4.08, S.D. = 0.72) has the higher mean value.

Also, the item is "The teacher gave a clear example of the problem. Help you understand the content and solve math problems." ($\bar{x}$ = 3.83, S.D. = 0.68) has the lowest mean value, compare to other items and the overall mean value of this construct.

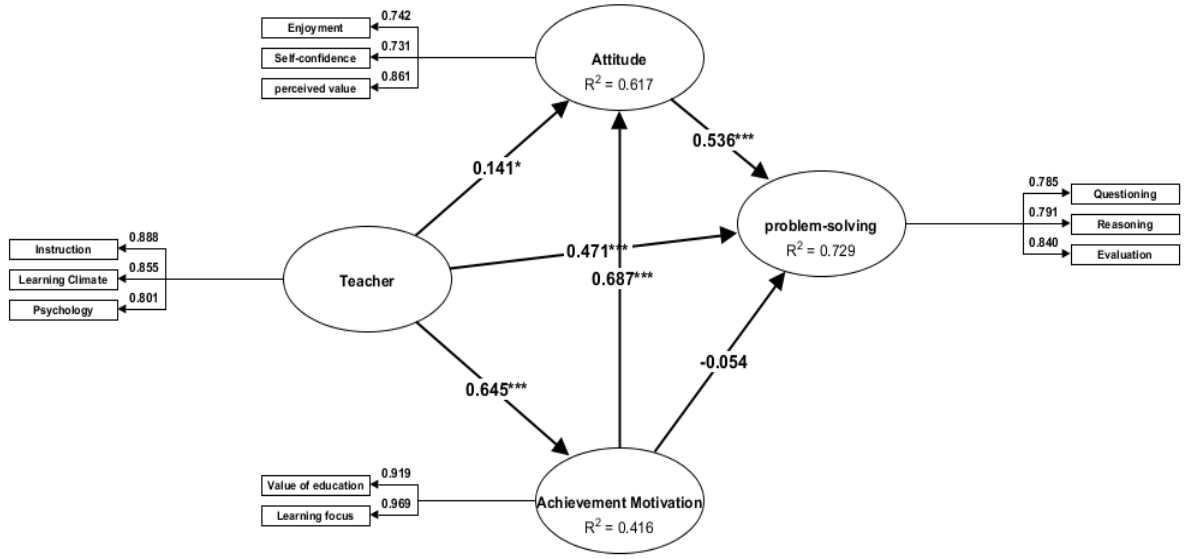

Figure 2 The results of Research and Hypothesis Testing
Note: *** p < 0.001; ** p < 0.01; * p < 0.05

Table 4 showed the result of the testing hypothesis. From the Structural Equation of mathematical problem-solving competency model testing, it was found that the factor with a positive effect on mathematical problem-solving competency are Teacher teaching (β = 0.4709, P < 0.00) and attitude towards mathematics (β = 0.5357, P < 0.00). Therefore, accept hypotheses H3 and H6. The factors with a positive impact on attitude towards mathematics are achievement motivation (β = 0.6867, P < 0.00) and Teacher teaching (β = 0.1415, P < 0.0384). Therefore, accept hypotheses H1 and H4. The factors with a positive impact on achievement motivation is only Teacher teaching (β = 0.6448, P < 0.00). Therefore, accept hypotheses H2. However, achievement motivation does not positively affect the mathematical problem-solving competency (β = -0.0538, P < 0.5283). Therefore, reject hypotheses H5.

Table 4 Path Coefficient and Hypothesis Testing Results

Effect/ Hypothesis	Original Coefficient	Mean value	Standard Error	t-value	p-value (2-sided)	Interpretation
H1 Teacher teaching → Attitude Towards Mathematics	0.1415	0.1413	0.0682	2.0735	0.0384	Accept
H2 Teacher teaching → Achievement Motivation	0.6448	0.6444	0.0382	16.8194	0.0000	Accept
H3 Teacher teaching → mathematical problem-solving competency	0.4709	0.4664	0.0605	7.7794	0.0000	Accept
H4 Achievement Motivation → Attitude Towards Mathematics	0.6867	0.6870	0.0570	12.0502	0.0000	Accept
H5 Achievement Motivation → mathematical problem-solving competency	-0.0538	-0.0553	0.0853	-0.6308	0.5283	Reject
H6 Attitude Towards Mathematics → mathematical problem-solving competency	0.5357	0.5417	0.0886	6.0440	0.0000	Accept

Discussion

Factors Influencing Attitude Towards Mathematics

According to the research, the factor affecting students' attitudes towards mathematics or solving math problems was the behavior of teachers towards students. Teacher teaching is very important to students' views on mathematics. Teachers should choose a teaching method that is appropriate for the content and educational level of the learners so that students can learn fully without too much stress and have a positive attitude towards mathematics. Teacher psychology is one of the things that every teacher must-have for teachers to understand their students better. Teachers need to understand the basics of students' knowledge, emotions, and learning needs. A teacher with psychology will be able to make students feel trusting. Students

will feel the teacher's love and care will make students feel relaxed, resulting in students having a positive attitude towards mathematics and wanting to learn more about math.

The need to be successful in solving math problems or the need to have a high grade in mathematics can be said to be a motivator for achievement is another factor that affects students' attitudes towards mathematics. Achievement-motivated students have the desire to achieve their desires, which in turn drives students to have a good idea. It can be said that students who want to be successful in solving math problems need to have a good feeling or attitude about mathematics before they are encouraged to have a sense of purpose in learning that leads to good mathematical achievements. When students have clear goals for studying mathematics and students realize the value of education as a result, students develop a positive attitude towards mathematics. Students will have confidence in themselves, dare to think, and dare to express their opinions. Making students learn math happier and more fun in learning. the results of the research are similar to (Marchis, 2011) that teacher is the most essential factor: the teacher's attitude towards mathematics, as well as the amount of confidence and support he or she gives to the student, influence the student's attitude towards mathematics. Another crucial factor is how students see mathematics' utility in their daily lives. Students' attitudes about learning mathematics are also influenced by self-efficacy and self-judgment. Generally, the kids had good attitudes toward mathematics, and the primary effects of grade and math achievement on these attitudes were also underlined. Although the girls' attitudes continued to deteriorate as they advanced through school, no gender effect was seen. Motivation-related variables are the key determinants of attitudes toward mathematics, according to a hierarchical study utilizing structural equation modeling, and teachers and peer social support are also important in understanding these attitudes. (Mata et al., 2012). Moreover, learning environment and teacher’s factor are two factors that need the institutions’ consideration in producing students with positive attitude towards mathematics (Maat & Zakaria, 2010).

Factors Influencing Mathematical Problem-Solving Competency

One factor that influences mathematical problem-solving competency is the attitude towards mathematics. This may be related to the fact that Students' attitudes about mathematics have an impact on their ability to solve math problems in the classroom through attention. Because students have a positive attitude towards mathematics and see the importance of learning to apply information to everyday life, the subject attitude has a favorable effect on student problem-solving at a significance level of 0.01. The students will then love and enjoy learning. Students with a strong concentration on problem-solving are more self-assured and capable of growing as problem solvers. Students who have a good attitude towards mathematics are more likely to pay attention and seek additional information, study independently, and investigate new arithmetic problems for self-training, allowing them to become adept at solving more math problems.

Teacher teaching are one aspect that determines problem-solving ability in mathematics. This may be because teachers' actions had both direct and indirect effects on students' mathematical problem-solving abilities, with the latter being mediated by achievement motivation and attitude toward mathematics. The teacher's behaviors had a positive effect on students' problem-solving ability at the 0.01 level of significance in this study because the teacher had managed the class with various activities, the educational tools were appropriate for the students, and the teacher knew about the psychology of teaching to meet each student's need. Furthermore, the teacher's assessment or evaluation matched with the curriculum's objective. The findings of this study were linked to those of Pimta et al. (2009). The findings revealed that the teacher's demeanor had a direct impact on the students' problem-solving ability. Students were encouraged to be enthusiastic, responsible for their learning, and to have a positive attitude toward the subject as a result of these actions and they would enhance themselves

Achievement Motivation does not significantly influence mathematical problem-solving competency. This may be because students who want to be successful in solving math problems can't be without patience, love, care, or a positive attitude towards mathematics because it can affect student success in mathematical problem-solving competency. Therefore, students need to solve math problems. Students also need to have a positive attitude towards mathematics. From the results of the research, it was found that achievement motivation was the indirect factor influencing students' problem-solving ability by passing through the attitude towards mathematics. This was because the achievement motivation was the students' desire to do anything to get a successor to do better than any other people. Therefore, if students have an achievement motive to solve the mathematic problems effectively, they will have a good attitude toward the subject as well. When students see the value of learning mathematics, they want to be successful in their studies, it will make them happy and have more goals in learning, resulting in students having a positive attitude towards learning mathematics happy and fun to constantly research to improve me in solving math problems. Moreover, when students have a desire to be successful, are motivated to study, and have a positive attitude towards mathematics, they will encourage students to be able to solve math problems sustainably.

Teachers should diversify and modernize their teaching methodologies, assessments, and evaluations, and incorporate psychology into their mathematic activities, particularly problem solving when they were interested, willing, and delighted in solving mathematic difficulties. Since the findings of the study revealed that teacher behavior had both direct and indirect effects on students' mathematic problem-solving abilities. Teachers are expected to research the ways for developing this ability in-depth and then bring them into the classroom to manage activities that help students to be excited about learning and have a positive attitude toward mathematic learning or to get students' attention. The kids' ability to solve mathematic problems will improve as a result. Teachers should also encourage students to develop self-efficacy, self-esteem, and self-respect because these factors help students develop a higher achievement motivation, and if students have a high achievement motivation, they will have a positive attitude towards mathematics learning, focus on learning, and be as successful in their studies as they expect. Which the results of the research are consistent with (Pimta et al., 2009) that The students had a positive attitude towards mathematics and recognized the importance of learning in order to apply what they had learned in the classroom to their daily lives. As a result, the students loved and enjoyed learning, they also concentrated on problem solving, and they were able to improve as a result. Teachers' activities influenced students' problem-solving ability in both direct and indirect ways, with the latter being mediated by achievement motivation and attitude toward the subject. Student attitudes toward science, as well as teacher support, have a substantial impact on student progress (Veloo et al., 2013). and previous researchers found a positive significant association between students' attitude toward learning and accomplishment motivation ($r = 0.53$, p.001), as well as a positive significant correlation between students' attitude and academic achievement ($r = 0.16$, p.001) (Bakar et al., 2010).

Conclusion

The purpose of this research is to study the influences affecting problem-solving in mathematics. The student's attitude towards mathematics is the most crucial component. Students will attempt to learn and develop without the assistance of teachers, and student learning will occur on a continuous basis. If a student has to solve a difficult problem, he or she will not be discouraged or exhausted from trying to find the answer. Students' attitudes towards math can be developed or students can feel good about math through teacher teaching behaviors. From the research results, it was found that the teaching and learning activities of the teachers affected the attitudes of the students. Therefore, teachers must organize teaching activities that are suitable for students according to the context and abilities of the students.

This is because students' behaviors and original ideas are different, so teachers must use psychology to teach students, that is, teachers must understand students. Giving students love makes students feel comfortable and worry-free when learning math so that students can think and share with teachers and classmates.

In addition, teachers who have techniques for teaching students will result in students' interest in mathematics. Students will have a desire to learn. Students are more motivated by research showing that achievement-motivated students also contribute to positive attitudes. When students want to be successful in solving problems. Students are motivated to try to solve any problem. To solve any problem, to be successful, students must also have a positive attitude because students will need patience and effort in solving math problems that require preference. and love, along with the learning of the students. The researcher concludes that teacher teaching behaviors affect students' ability to solve mathematical problems. Including students with a positive attitude towards mathematics will result in students' ability to solve math problems as well. However, the teacher's teaching style affects the students' attitudes and the students' achievement motivation. Therefore, any educational organization that needs to develop students' problem-solving abilities must take into account the teaching behavior of teachers and also the attitudes of students. If teachers can make students love math, they will be able to develop their problem-solving abilities on their own and will never stop improving themselves.

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