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# Factors Affecting Self-determination in Mathematic Learning of Thai Grade 8 Students

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**Abstract**

The purposes of the study were to investigate the relationship between factors and self-determination in learning mathematics of grade 8 students in Thailand and to study factors affecting self-determination in learning mathematics of grade 8 students. The participants were 500 students in an area called Bueng Kan province in Thailand. They were selected using multi-stage random sampling from the population of 872 grade 8 students in the area. The instrument was an assessment of grade 8 students' self-determination in learning mathematics. The assessment consisted of 70 items assessing factors that could affect students' self-determination and 30 items assessing students' self-determination in learning mathematics. The assessment items were proved with 0.34-0.62 discrimination and 0.96 reliability. The data were analyzed using percentages, mean scores, standard deviation, and Stepwise Multiple Regression Analysis. The variables used in the data analysis were intrinsic motivation ($X_1$), attitude toward mathematics ($X_2$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), teacher-student relationship ($X_5$), problem-solving abilities ($X_6$), and social support ($X_7$) as predictions while self-determination in mathematics learning (Y) was set as the criterion. The results of the study indicate that the Stepwise Multiple Regression Analysis indicates 4 factors including intrinsic motivation, learning behaviors,

teacher instruction technique, and the teacher-student relationship showing a correlation to self-determination in learning mathematics. Moreover, the predictable factors were intrinsic motivation ($X_1$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), and teacher-student relationship ($X_5$). They could predict approximately 76.00% of self-determination. The predictable equation in raw scores and standard scores were, $Y' = 0.06 + 0.52X_1 + 0.27X_3 + 0.09X_5 + 0.12X_4$; $Z'_s = 0.53Z_1 + 0.26Z_3 + 0.11Z_5 + 0.13Z_4$.

**Keywords:** Self-determination, Mathematics education, Factors

## 1. Introduction

Learning mathematics is fundamental for calculation-based subjects throughout the education system of most students around the globe. With a great command of mathematical ability, students could do well in science subjects and mathematics itself. They could also apply the mathematical knowledge in class to daily activities with are various from calculating goods prices to managing taxes. According to Yadav (2019), mathematical-related skills are essential in the development of high-paid careers such as engineers, managers, computer programmers, etc. Therefore, the subject is considered a core subject in the modern education system.

However, learning mathematics is complicated as learners need to comprehend theories and apply them in solving mathematical problems. They also need to develop skills such as problems solving skills, analytical skills, logical thinking, etc. Langoban (2020) suggested that the combination of teaching methods, students' experiences, and the learning environment makes mathematics difficult. Likewise, Gafoo and Kurukkan (2015) indicated that teaching style, difficulty in following the instruction, difficulty in understanding the subject, and difficulty in remembering its equations and ways to solve problems are reasons why students perceive mathematics as a difficult subject. Therefore, it is not a surprise that developing students' mathematical abilities is considered one of the major problems in education settings worldwide.

To become competent in learning mathematics, learners need self-determination in learning. The concept of self-determination has been discussed widely across the area of mathematics education. For example, Habibi et al. (2018) claimed that self-determination can be recognized as the person's intention that arises as a result of awareness emergence about the significance and benefits of things to an individual. Similarly, self-determination is also defined as the capacity to establish and attain goals based on the foundation of one's ideals (Field & Hoffman, 1994). It could also be noted that learners need both intrinsic motivation and intrinsic regulation to establish self-determination in learning. Without motivation and regulation, serious behaviors cannot be driven out. Therefore, learners with self-determination could do well in mathematics classes as they are aware of the importance of the subject and eager to put the best attempt to learn it.

In learning mathematics, quality is needed as it is beneficial in motivating learners to determine in learning the subjects. As discussed before, mathematics is complicated, and its nature could demotivate students in the classes. Considering the position of the subject in the

curriculum, students who fail in a matching class might lose the intention to learn the subject in the previous years. Several studies have demonstrated a positive relationship between self-determination and learning outcomes (Reeve, 2012). When it comes to accessing one's information, whether that knowledge is already known or is still being learned, the desire to determine one's destiny based on one's own internal motivation has a significant impact on one's capacity for self-control. These mentalities have a direct bearing on how well people can absorb new information (Ryan & Deci, 2000).

Therefore, establishing learner self-determination could be a key to developing learning achievement in mathematics classes. However, to understand self-determination in learning, factors that affect learners' decision to choose a subject they determine to learn are needed to be studied. Especially in such a complicated subject as mathematics, several studies have been conducted to investigate factors that contribute to self-determination in learning calculation-based concepts (*e.g.*, Crawford, 2017; Habibi et al., 2018; Kosko & Wilkins, 2012; Muir, 2021; Saleh, 2014; Teppo et al., 2020). These factors are presented in detail in the following table.

Table 1. Factors affecting self-determination in mathematics learning in previous studies

| No. | Studies | Factors |
|---|---|---|
| 1. | Muir (2021) | Sense of competence<br>Sense of autonomy<br>Sense of relatedness |
| 2. | Teppo et al. (2020) | Intrinsic motivation<br>A valuable addition to being competent |
| 3. | Kosko and Wilkins (2012) | Autonomy<br>Competence<br>Relatedness |
| 4. | Habibi et al. (2018) | Self-awareness<br>Perceived choice<br>Competence<br>Relevance |
| 5. | Crawford (2017) | Autonomy<br>Competency<br>Relatedness |
| 6. | Saleh (2014) | Understanding<br>Interests/Preferences<br>Effort/Importance<br>Selection<br>Value/Use<br>Relationship<br>Pressure/Tension |

Therefore, it could be synthesized that the factors that could affect students' self-determination in learning mathematics could be from the student aspect, teaching aspect, and environmental aspect. The following issues could be disused to explain mathematics self-determination.

### *1.1 Intrinsic Motivation*

It should be noted that students can engage in a mathematical learning activity for its intrinsic value, rather than for a specific outcome. When they are intrinsically motivated, the students act because of the enjoyment or challenge involved, as opposed to rewards.

*1.2 Attitude toward Mathematic*

To establish self-determination in learning mathematics, students have to value the subject in their educational path. In other words, mathematics should be considered beneficial in students' plans of study and future careers.

*1.3 Learning Behaviors*

Learning behaviors could also signify self-determination in learning mathematics. Learners with self-determination would put the best attempt in learning the subject.

*1.4 Teacher Instruction Technique*

Teaching methods are crucial in developing a learnable class atmosphere. Teachers' instructional techniques could bring about a positive attitude toward learning mathematics and contribute to self-determination in learning the subject.

*1.5 Teacher-Student Relationship*

A learnable class atmosphere can also be caused by the camaraderie of teachers and students. The teacher-student relationship is crucial in improving learning discussions and activities. Students with an open mind (to their teachers) would be eager to learn the subject with self-determination.

*1.6 Problem-Solving Abilities*

Problem-solving is an important skill in learning mathematics. The ability to use systematical thinking in putting components in solving mathematical problems could also contribute to self-determination in learning mathematics.

*1.7 Social Support*

The need to be recognized among society members is human nature. With social support, learners could perceive mathematics as a skill that gains them social recognition, and it leads to self-determination in learning.

It could be seen that self-determination is important in learning mathematics. Moreover, understanding factors affecting self-determination would be beneficial in establishing the quality of learners in mathematics classes. The current study, therefore, aims to investigate issues that affect the determination in learning mathematics of grade 8 students in Thailand. The purposes of the study were to investigate the relationship between factors and self-determination in learning mathematics of grade 8 students in Thailand and to study factors affecting self-determination in learning mathematics of grade 8 students.

## 2. Methodology

*2.1 Participants*

The participants were 500 students in an area called Bueng Kan province in Thailand. They were selected using multi-stage random sampling from the population of 872 grade 8 students in the area. The participants took over 10 courses of mathematics throughout the basic

curriculum of the Thai Education system (Ministry of education, 2008). They took an assessment form, and the results were used to fulfill the purposes of the study. The participants' profiles were kept confidential, and they were treated considering the ethics of conducting research with human subjects.

*2.2 Instruments*

The instrument was an assessment of grade 8 students' self-determination in learning mathematics. The assessment was divided into 2 parts: 1) 70 items assessing factors that could affect students' self-determination in learning mathematics and 30 items assessing students' self-determination in learning mathematics. The assessment items were proved with 0.34-0.62 discrimination and 0.96 reliability.

*2.3 Data Collection and Analysis*

The data collection took place in Bueng Kan province in Thailand. The assessment form was distributed throughout the target area. The data were analyzed using percentages, mean scores, standard deviation, and Stepwise Multiple Regression Analysis. The variables used in the data analysis were intrinsic motivation ($X_1$), attitude toward mathematics ($X_2$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), teacher-student relationship ($X_5$), problem-solving abilities ($X_6$), and social support ($X_7$) as predictions while self-determination in mathematics learning (Y) was set as the criterion.

## 3. Results

Table 2. Correlation coefficients of prediction and criterion variables

| Variables | $X_1$ | $X_2$ | $X_3$ | $X_4$ | $X_5$ | $X_6$ | $X_7$ | Y |
|---|---|---|---|---|---|---|---|---|
| $X_1$ | 1.00 | | | | | | | |
| $X_2$ | 0.73** | 1.00 | | | | | | |
| $X_3$ | 0.69** | 0.82** | 1.00 | | | | | |
| $X_4$ | 0.64** | 0.69** | 0.73** | 1.00 | | | | |
| $X_5$ | 0.28** | 0.26** | 0.25** | 0.22** | 1.00 | | | |
| $X_6$ | 0.69** | 0.82** | 1.00** | 0.73** | 0.25** | 1.00 | | |
| $X_7$ | 0.64** | 0.69** | 0.73** | 1.00** | 0.22** | 0.73** | 1.00 | |
| Y | 0.83** | 0.73** | 0.75** | 0.69** | 0.35** | 0.75** | 0.69** | 1.00 |

*Note*. ** $p < .01$.

The results of the study indicate that prediction variables and the criterion were significantly correlated at a statistical difference of .01. In detail, all variables were found to be positively

correlated. Comparatively, the prediction variables of intrinsic motivation ($X_1$) (r = 0.83), learning behaviors ($X_3$), (r = 0.75), problem-solving abilities ($X_6$) (r = 0.75), teacher instruction technique ($X_4$) (r = 0.69), social support ($X_7$) (r = 0.69), and teacher-student relationship ($X_5$) (r = 0.35) were found to be in an ascendant order respectively. Therefore, all variables can be used in the Stepwise Multiple Regression Analysis.

Table 3. Stepwise Multiple Regression Analysis of prediction variables and criterion

| Prediction variables | R | $R^2$ | $R^2_{adj}$ | $SE_{est}$ | F | p |
|---|---|---|---|---|---|---|
| $X_1$ | 0.83 | 0.69 | 0.69 | 0.26 | 1084.874** | .000 |
| $X_1$,$X_3$ | 0.86 | 0.75 | 0.75 | 0.23 | 735.725** | .000 |
| $X_1$,$X_3$,$X_5$ | 0.87 | 0.76 | 0.76 | 0.23 | 519.396** | .000 |
| $X_1$,$X_3$,$X_4$,$X_5$ | 0.88 | 0.77 | 0.76 | 0.22 | 404.773** | .000 |

According to the Table 3, a stepwise multiple regression analysis of prediction variables and criteria indicates that 4 out of 7 prediction variables including intrinsic motivation ($X_1$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), and teacher-student relationship ($X_5$) were found to affect self-determination in learning mathematics at a statistical level of .01. Moreover, they could predict the criteria at 76.00%. Considering each prediction variable, it was found that the intrinsic motivation ($X_1$) could predict self-determination in learning mathematics at 69.00%; learning behaviors ($X_3$) could predict self-determination in learning mathematics at 75.00%; teacher-student relationship ($X_5$) could predict self-determination in learning mathematics at 76.00%; teacher instruction technique ($X_4$) could predict self-determination in learning mathematics at 76.00%.

Table 4. The relationship between the raw score and standard score in the predictable equation

| Prediction variables | b | β | t | p |
|---|---|---|---|---|
| Constant | 0.06 | - | 0.478** | .633 |
| $X_1$ | 0.52 | 0.53 | 16.887** | .000 |
| $X_3$ | 0.27 | 0.26 | 7.377** | .000 |
| $X_5$ | 0.09 | 0.11 | 4.750** | .000 |
| $X_4$ | 0.12 | 0.13 | 3.932** | .000 |

*Note*. ** p < .01.

The results of the study show that the predictable factors were intrinsic motivation ($X_1$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), and teacher-student relationship ($X_5$). The predictable equation in raw scores and standard scores were

$$Y' = 0.06 + 0.52X_1 + 0.27X_3 + 0.09X_5 + 0.12X_4 \quad (1)$$

$$Z'_s = 0.53Z_1 + 0.26Z_3 + 0.11Z_5 + 0.13Z_4 \quad (2)$$

## 4. Discussion

The results of the study indicate that factors that statistically affected the participants' self-determination in learning mathematics were intrinsic motivation ($X_1$), learning behaviors ($X_3$), teacher instruction technique ($X_4$), and teacher-student relationship ($X_5$). Each issue can be discussed below.

### *4.1 Intrinsic Motivation*

Intrinsic motivation is also presented in Habibi et al. (2018) and Teppo et al. (2020) as a factor leading to self-determination in learning mathematics. Quality is simply defined as the eagerness to learn a subject without thinking of the outcomes. Therefore, participants in this study were motivated to learn mathematics because they held favorable attitudes toward the topic and enthusiastically participated in activities that were presented in class. In this case, the enjoyable feeling of learning mathematics could contribute to self-determination.

### *4.2 Student Learning Behaviors*

The factor of student learning behaviors was also found to affect self-determination in learning mathematics. The results of the study were consistent with Brenner (2022) who also suggested that students who can self-regulate their learning can prioritize making the most of their efforts to achieve the highest possible level of learning achievement in the topic. Moreover, to establish self-regulated learning behaviors, learners could utilize the metacognitive skills that allow them to notify their strengths and weakness in learning. They could also use learning strategies effectively in dealing with difficult tasks of mathematics. Extensive learning strategy repertories also allow them to be adaptable and versatile in their use of strategies and can modify strategies to meet the requirements of a variety of tasks (Winne & Perry, 2000). These learning behaviors and self-determination would occur parallelly.

### *4.3 Teacher Instruction Techniques*

Teaching techniques could bring about a learnable atmosphere in classes, and in this study, it could also contribute to self-determination in learning mathematics. The result of the study went in line with Koka and Hagger (2010) as it also shows how teachers' teaching techniques affect learners' determination. According to the authors, teachers need to carefully choose learning activities and class management methods in teaching. They have to keep in mind that both verbal and instructional aspects of teaching could affect students' perception of learning. The result of the study also evidences the Thai learners' nature of teacher-dependent learning behaviors. Masuk (2021) found that Thai learners, especially in their early teens,

value teachers as their leaders in education. Therefore, applying an effective instructional technique would bring about self-determination in learning.

*4.4 Teacher-Student Relationship*

Another predictable factor found in the current study is the teacher-student relationship. The results of the study were related to Koca (2016) as the study also found a relationship between the concept of motivation and determination in learning and the relationship between teachers and students. According to the author, Teachers have the potential to act as social agents, and they have the ability to develop their students' intellectual and socioemotional by fostering an environment conducive to learning and student motivation. Therefore, healthy relationships between teachers and students can result in a welcoming classroom environment, which enables students to successfully adjust to their new school environment and consequently increases their determination to learn.

## 5. Conclusion

Consequently, it could be summarized from the results of the study that factors that affected the mathematical self-determination of the participants in the current study were intrinsic motivation, learning behaviors, teacher instruction technique, and the teacher-student relationship. The results support Brenner (2022), Habibi et al. (2018), and Teppo et al. (2020) who also found the similar factors affecting mathematical self-determination in learning. These factors could be considered predictable factors in developing students' self-determination in learning mathematics in further studies. The results of the study could also provide pedagogical implications for math education as teachers could consider the factors of intrinsic motivation, learning behaviors, teacher instruction technique, and the teacher-student relationship in designing learning activities which could contribute to both self-determination and learning achievement. Moreover, policymakers could also consider these factors in making policy in math education.

In summary, students learn from every experience they encounter. They have a natural inclination to explore their environment and discover new things. During these formative years, students develop perspectives on education and education in general that will later serve as a foundation for their formal education experiences. When we provide students with the appropriate support and encouragement during these years, they would determine to put their best attempts into learning despite dealing with such a difficult subject as mathematics. In contrast, those who do not receive this assistance are less likely to endure the educational path. Therefore, stakeholders in education should work together to establish self-determination in learning as it is the first gate to successfully acquiring the skills and knowledge learned in all areas.

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