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Determinants of Willingness to Study Mathematics and Actual Performance: An Application of the Theory of Planned Behavior

Anita Causaren
Department of Mathematics, MSME, Assumption University
acausaren@au.edu
Sasima Ratanasut
Department of Mathematics, MSME, Assumption University
sasimartn@msme.au.edu
Augkana Tiyajamorn
Department of Mathematics, MSME, Assumption University
angkanatyj@msme.au.edu
Orasa Pojeakpong
Department of Mathematics, MSME, Assumption University
orasapjk@msme.au.edu

Abstract
The purpose of this quantitative study is to examine in light of the theory of planned behavior how students' attitude toward mathematics affects their willingness to study mathematics and their performance. As was the case in previous studies, student willingness to study mathematics is conceptualized as a predictor of actual performance. The conceptual framework outlines the relationship between student confidence, anxiety, ability, and self-control, on the one hand, and student willingness to study mathematics and actual performance on the other. Data was collected from students enrolled at a private university in Bangkok, Thailand, via a questionnaire. A factor analysis was conducted to generate unidimensional constructs with construct validity and reliability. Multiple regression was used to test the research framework. The results show that student confidence, student anxiety, student ability, and student self-control influence student willingness to study mathematics, which in turn affect students' actual performance in mathematics. The results could be utilized to reinforce student performance in mathematics and create an interesting mathematics class experience and be applied to similar courses that generate high student anxiety.

Keywords: Theory of Planned Behavior, Actual Performance, Willingness to Study Mathematics, Student Attitude, Perceived Behavioral Control

1. Introduction

Studying student performance is crucial. For one thing, understanding the behavior causing students to perform poorly or strongly in a particular course helps to devise remedial measures. For another, it is a key indicator of the efforts by learning institutions to generate high quality graduates who will be tomorrow's talented leaders and competent employees (Chionh & Fraser, 2009). Previous studies on student performance essentially focused on gender difference (Marks, 2008), teacher's education and teaching style (Wentzel, 2002), class environment (Chionh & Fraser, 2009), socio economic factor and family education background, class schedules, class size (Heinesen, 2010), mathematics text books, homework (Törnroos, 2005), exams systems, extracurricular activities (Bishop, 1998), and technology used in the class (Freeman et al., 2014).

The findings in these studies vary from context to context. Since not all variables are applicable to a particular situation, it is important that formal studies be performed to establish context-specific determinants for sound decision-making. This study is an attempt to bridge the gap found in previous studies in relation to the theory of planned behavior and actual performance in education. In a nutshell, the theory of planned behavior argues that an individual's specific behavior is determined by his/her intention to perform (willingness) and that both behavior and intention can be predicted by attitude toward that behavior, subjective norms, and perceived behavioral control (Ajzen, 1991). Specifically, this study takes a theory of planned behavior perspective (Niepel et al., 2018; Mazana, Montero, & Casmir, 2019) to understand student willingness to study basic mathematics (hereinafter 'math' or mathematics) and how student performance can be improved. The course at the root of this study is a course in basic mathematics offered as a non-credit subject.

In order to determine how student performance can be enhanced, this study examines the relationship between the determinants of willingness to study mathematics and actual performance. To achieve this purpose, it develops a conceptual framework that applies the theory of planned behavior and evaluates the framework by using a survey method. More specifically, this study seeks to answer the following research questions:

(1) What are the factors affecting student willingness to study mathematics and what are their relationship with it?
(2) How does student willingness to study mathematics affecting student actual performance?

Although it is helpful to study the relationship between student willingness to study mathematics and actual performance, there are not many studies examining the suitability of the application of the theory of planned behavior in the education field, especially in the study of mathematics in the Thai context.

2. Literature Review

Figure 1 shows this study's conceptual framework.

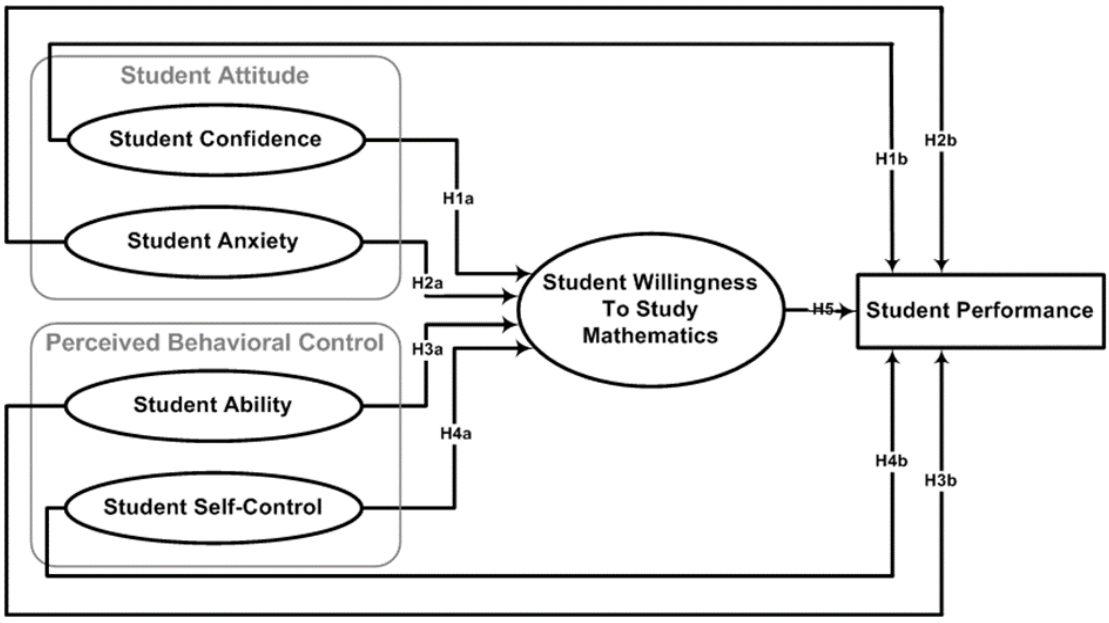

Figure 1: Conceptual Framework (Created by the authors for this study)

Before exploring all the constructs at the core of this study, it is necessary first to briefly discuss the theory of planned behavior and its emphasis on student confidence and student anxiety are indicators of student attitude towards mathematics. As shown in Figure 1, both variables are part of this study's conceptual framework.

- The Theory of Planned Behavior

The theory of planned behavior is a prominent theory in the field of changing human behavior. As noted above, the theory is based on three independent determinants, which are (i) attitudes toward behavior, (ii) subjective norms, and (iii) perceived behavioral control (Fishbein & Ajzen, 2010). However, because every student in this study is required to study mathematics regardless of his/her personal preferences, the subjective norm determinant will be excluded. This is all the more warranted as there have been precedents for excluding it. Magnusson et al. (2001), for example, excluded subjective norm from their study. Moreover, when included in a model, its explanatory power is surprisingly small as was the case in Sparks and Shepherd's (1992) study. The theory has been widely implemented to the health care domain (Liao, Chen, & Yen, 2007; Ranjbarian, Gharibpoor, & Lari, 2012).

However, according to Ajzen and Manstead (2007), the theoretical conclusions of the theory can equally be applied to behaviors in other areas such as information systems and education to name a few. Indeed, the theory is well suited to identify factors that could help students increase their willingness to study mathematics. These include student confidence, student anxiety, and perceived behavioral control as well as ability and self-control. As the discussion of these constructs in the next several paragraphs will make it clear, they influence student willingness to study mathematics and actual performance

- Student Attitude Toward Mathematics

According to Fishbein and Ajzen (2010), attitude is a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object. Aiken (1970) defined attitude toward behaviors as an individual tendency to respond positively or negatively to an attitude object, i.e., a situation, concept, or person. The attitude variable is one of the most potent factors that relates to achievement (Borasi, 1990). A student's attitude and confidence could be difficult to change. This is of no consequence if a student has a good attitude but it could be very problematic when a student's attitude and confidence are negative (Piper, 2008). Once a student becomes anxious, bored, fearful, or simply believe that mathematics is unimportant, he/she will be unwilling to study mathematics (Furner & Berman, 2005). In their studies, Kloosterman, Raymond, and Emenaker (1996) found that 66 percent of student attitude and confidence remained constant from year to year. Students who reported a change in their level of confidence saw only a change from one level to the next and students with low confidence never moved to high confidence and vice versa. The nature of mathematics causes panic and anxiety among students (Zimmerman, 2000). As shown in Figure 2 and in line with the theory of planned behavior, in this study, student attitude toward mathematics is indicated by (i) student confidence and (ii) student anxiety. Both indicators are discussed next.

> *(i)* ***Student Confidence –*** Reyes (1984) defined confidence as an individual perception of self. According to McElmeel (2002), it is a faith or belief in oneself and ones' own abilities to succeed. Students' confidence in their ability to solve problems play a significant role in mathematics achievements (Mohd, Mahmood, & Ismail, 2011). Student confidence in mathematics is the ability to succeed in mathematics and the feelings about mathematics (McMullen, 2005). It affects their motivation to learn mathematics. Mazana et al. (2019) found that students tend to believe that they are not good at mathematics. Students who lack confidence perceive mathematics as difficult,

which leads to a poor grades and dislike of mathematics (Simmers, 2011; Burton, 2004). Highly confident students who believe in their mathematical abilities are more likely to overcome the fears of failing (Van der Bergh, 2013). According to Skinner and Belmont (1993), students who are confident and motivated will often select a task at the boundary of their competencies, initiate action when given the chance to do something, become passionate in the application of the work, and perceive positive emotions during the ongoing action such keenness, enjoyment, and hopefulness.

(ii) ***Student Anxiety*** **–** Miller and Mitchell (1994) defined mathematics anxiety as a meaningless state of mind that induces fear when focusing on mathematics and affects students' performance negatively and prevent them from learning. It can also be defined as panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematics problem (Tobias & Weissbrod, 1980). Such anxiety impairs the mathematical cognitive process of students (Cassady & Johnson, 2002), makes learning harder (Sheffield & Hunt, 2007), and reduces students' relationships with mathematics (Tooke & Lindstrom, 1998). Moreover, students who are math anxious always experience increased levels of anxiety in math-related situations (Spielberger, 1985). As Hopko, McNeil, Zvolensky, and Eifert (2001) reported, students with medium or high mathematics anxiety experienced an impairment of their reading processes when the text was related to math. If students experience hardship from mathematics anxiety, their willingness to study and be successful in mathematics courses will diminish (Stubblefield, 2006). Moreover, Akinsola, Tella, and Tella (2007) found that math-anxious students tend to avoid mathematics-related situations and courses and exhibit procrastination behavior. Mathematics anxiety is a widespread problem, especially in tertiary education. According to Ashcraft and Moore (2009), 17 percent of the U.S. population suffer from high level of mathematics anxiety.

- Perceived Behavioral Control

Perceived behavioral control (Ajzen, 1991) is a key component of the theory of planned behavior discussed earlier. The concept of perceived behavioral control is especially useful for assessing an individual actual control for specific situations (Ajzen, 2002). A high level of perceived behavioral control strengthens an individual's intention to act upon the behavior, whereas a low level means less motivation to act upon the behavior. Since learning involves acquiring knowledge and behavioral skills, the main aspect of student performance and academic achievement is how to capture knowledge (Orrell, 2006). Viewed from this perspective, students have a chance to acquire knowledge with their unique ability (Kutnowski, 2005). When students are passionate about learning, their learning preference and learning skills enable them to acquire and modify their existing knowledge and develop self-control (Boud, Keogh, & Walker, 2013). As shown in Figure 2 and in line with the theory of planned behavior, in this study, student perceived behavior control is indicated by ((i) student ability and (ii) student self-control. Both indicators are discussed next.

(i) Student Ability **–** Student ability to learn mathematics is the capability to understand, handle, and work with numbers effectively. Obviously, the higher the mathematical ability of a student, the higher his/her achievement in math. Conversely, the lower the mathematical ability of a student, the lower his/her achievement in math (Nizoloman, 2013). Many students perceive that mathematics as the most difficult subject regardless of its importance in their lives (Zakaria & Ngah, 2011; Cai & Hwang, 2002). The difficulty of dealing with mathematical problem depends on the extent to which students believe in their own ability to succeed (Bandura, 1986*;* Carr & Sequeira,

2007). Student mathematical problem-solving ability is influenced by his/her confidence in one's ability influences (Bandura, 2010).

(ii) Student Self-Control **–** Self-control can be defined as one's ability to restrain oneself or hinder behavior or responses intentionally and consciously (Vohs & Baumeister, 2004). It is particularly helpful in overcoming affective, cognitive, and behavioral tendencies that would otherwise prevent people from achieving their goals (Baumeister, Vohs, & Tice, 2007). According to Tangney, Baumeister, and Boone (2004), self-control is important to take action pursuing one's ambition. Students who possess high self-control tend to get more benefits than those who have low self-control (Ent, Baumeister, & Tice, 2015). They have been found to have higher grades, be able to avoid dealing with alcohol and drugs, have better interpersonal relationships, and exhibit more emotional stability (Tangney et al., 2004). On the other hand, students with low self-control tend to cheat on examinations (Williams & Williams, 2012), gamble (Williams, 2010), drink and abuse drug (Ford & Blumenstein, 2013) and be unhappy (Dalton & Crosby, 2011). This ruins their willingness to study and impairs their performance (Goleman, 2001).

- Student Willingness to Study Mathematics

Willingness to study is defined as a desire, wish or readiness to acquire new knowledge (Yashima, 2002). As an inner strength influencing a student's performance, it is similar to willingness to learn, which refers to both professional competence and general education (Noplag Blog, 2017). Woolfolk and Margetts (2007) determined that one of the most significant factors in education is the willingness to study, appreciate, and be excited about what students are studying. When student willingness to study is high, they are more likely to find a significant learning challenge. In relation to math learning, willingness to study is likely to have a profound effect on success. Typically, students willing to study mathematics are highly motivated and have a good behavior and positive attitude towards studying mathematics (Tooke & Lindstrom, 1998). They tend to pay more attention to the learning process and math materials, assignments and examinations and tend to become more inquisitive of the content of the subject and be more actively engage in the process of learning math (Azmidar, Darhim, & Dahlan 2017). According to Saleh (2004), high achievers in math have a high level of willingness to solve mathematical problems compared to average and underachiever students.

- Student Performance

Performance is the result of an effort in the form of either knowledge or skills. Performance is achieved by doing something despite difficulty or delaying in achieving success (Maulida & Kariyam, 2017). Student performance is one of the most notable and significant predictors in the lives of the students. It predicts the extent to which students, teachers, and institutions have attained their educational goals and objectives. Student performance is important because it promotes success in their lives (Areepattamannil & Freeman, 2008). Factors affecting student performance, such as willingness to study, and academic and learning behavior, are equally important in discovering students' academic performance. The GPA is often used to measure student performance (Darling, Caldwell, & Smith, 2005). Some researchers, however, use test results or previous year result when focusing on performance for a specific subject (Hijazi & Naqvi, 2006; Amirtha & Jebaseelan, 2014).

3. Hypotheses Development

Several studies have determined that attitude (which in this study includes confidence and anxiety as we just saw) influences behavioral intention (Chen & Wu, 2020; Lin & Williams, 2016). In the field of education, a number of studies have established that there is a positive

relationship between student confidence and their willingness to study (e.g. Nazarova & Umurova, 2016; Sheldrake, Mujtaba, & Reiss, 2015).

It can therefore be hypothesized that:

H1a: *There is a relationship between student confidence and student willingness to study mathematics*.

H1b: *There is a relationship between student confidence and student actual performance in mathematics.*

As explained earlier, one type of anxiety is mathematics anxiety. Since as a negative emotional reaction to mathematics, anxiety in mathematics impedes students from solving mathematical problems (Ashcraft, 2002; Burrus & Moore, 2016), the present study can hypothesize that:

H2a: *There is a relationship between student anxiety and student willingness to study mathematics*.

H2b: *There is a relationship between student anxiety and students' actual performance in mathematics.*

Sáez et al. (2018) concluded that students with high levels of willingness to study show positive beliefs about their own ability to self-regulate their willingness to study.

H3a: *There is a relationship between student ability and student willingness to study mathematics*.

H3b: *There is a relationship between student ability and students' actual performance in mathematics.*

Hafilah and Usman (2019) collected data from accounting students at the State University of Jakarta and found that the higher the ability to control or manage their emotions, the better the level of understanding of accounting knowledge. Moreover, Kaiser, Hübner, and Bogner (2005) determined that perceived behavioral control, which consists of student ability and self-control, have an effect on students intention (willingness) to study. The following hypothesis can thus be developed:

H4a: *There is a relationship between student self-control and student willingness to study mathematics*.

H4b: *There is a relationship between student self-control and students' actual performance in mathematics.*

Tooke and Lindstrom (1998) argued that the willingness to solve problems played an important role in the achievement of mathematics. Moreover, Papanastasiou (2000) found that, compared to average and poor learners, outstanding students have a high degree of willingness to solve mathematics problems. The following hypothesis can therefore be proposed:

H5: *There is a relationship between student willingness to study Mathematics and students' actual performance in mathematics.*

4. Research Methodology

- Target Population and Data Collection

The data was collected from a target population consisting of students who took a course in basic mathematics in 1/2019 semester (August-October 2019) at one private Thai university. Basic mathematics is an introductory course for first year students majoring in business administration. This subject has been selected because it is a non-credit subject, which most students may not be willing to study, making it an interesting issue to examine.

In addition, since, in a competitive academic environment, it is important for private universities to be able to retain students, this study was conducted at a private university, hoping that its results would contribute to enhancing student performance, which in turn could lead to a high retention rate (Hasan, Ilias, Rahman, & Razak, 2008). The data was collected using online questionnaires distributed to 554 students who took basic mathematics. Since this study used census sample, no sampling method was used. Table 1 presents the profile of the 554 respondents. The majority of respondents in this study were Thai female students below 19 year old with a GPA of 3.00 or above.

Table 1: Student Profile (n = 554)

		Frequency	**Percent**
Gender	Male	193	34.8
	Female	361	65.2
Nationality	Thai	442	79.8
	Non-Thai	112	20.2
Age	Below 19 or equal	374	67.5
	20-21	108	19.5
	22 or above	72	13.0
GPA	Less than 2.00	22	4.0
	2.00-2.49	81	14.6
	2.50-2.99	76	13.7
	3.00 or above	153	27.6
	N/A	222	40.1

Note: N/A refers to first-year students who are in their first semester and therefore do not have a GPA yet.

- *Instruments*

All item measures were developed from previous studies using a 6-point Likert scale (e.g. strongly agree to strongly disagree) and revised to focus on mathematics as a subject. Since a 6-point Likert scale will classify respondents into groups that are easy to understand and interpret (Chang, 1994), it is a forced choice. Cronbach alpha was used to test reliable measures. Average variance extracted (AVE) and the composite reliability were employed to assess the convergent and discriminant validity applied (Fornell & Larcker, 1981). Moreover, this study ran an exploratory factor analysis to assess unidimensional constructs and test for the construct validity, both convergent and discriminant (see Tables 2 and 3). Student confidence was measured through eight items adapted from Mokhtar, Md Yusof, and Misiran (2012) and student anxiety through seven items adapted from Grootenboer and Hemmings (2007). To measure student ability, six items were adapted from Meece, Wigfield, and Eccles (1990). Six items adapted from Tangney et al. (2004) were used to measure student self-control. As to student willingness, it was measured through five items adapted from Pajares and Graham (1999). Finally, student actual performance was measured using a single item; the total 100 scores of quizzes, assignments, midterm, and final exam.

Table 2 shows the reliability and validity results for all measures. For reliability measurement, the Cronbach's alpha was used. Hair, Black, Babin, and Anderson (2010) suggested that the value of Cronbach's alpha for measurement scale should be 0.70 or greater, which indicate acceptable reliability. The results indicate that the Cronbach's alpha ranges from 0.716 to 0.919, which represents a good reliability of the measures. For validity measurement, an exploratory factor analysis was conducted so as to group item measures into a few concepts that closely mapped the literatures and make hypotheses testing possible while preserving most variation with simplicity (Jolliffe, 2010). A principal components analysis with varimax rotation and Kaiser normalization was considered appropriate as the number of samples (554) was more than five times the number of item measures (32) (Tabachnik & Fidell, 1996).

The factor analysis reduced the thirty-two item measures to five factors with eigenvalue at more than one and factors loading value at more than 0.500, ranging from .635 to .897 (Stevens, 1992). The Kaiser-Meyer Olkin (KMO) measure of sampling adequacy was 0.900 (Kaiser, 1974), indicating adequate sample size. The Bartlett Test of Sphericity (7037.344, $p < 0.0005$) indicates a significant correlation between item measures, which is valid to run a meaningful EFA, altogether confirming the validity of the measures (Norusis, 2005). Table 2 also shows a clear factor structure in which convergent and discriminant validity is evidenced by the high loadings within factors and no major cross-loadings between factors.

Table 2: Measurement Description

Constructs	**Factor Loadings**	**Means**	**SD**
Student Confidence in Math (α = .854, AVE=.705, CR=.749)	.635-.747 (var=11.5%)	3.31-3.43	1.51-1.56
Student Anxiety reagrding Math (α = .906, AVE=.787, CR=.908)	.653-.861 (var=22.55%)	3.27-4.14	1.49-1.83

Student Ability in Math (α = .862, AVE=.754, CR=.799)	.692-.807 (var=12.0%)	3.30-4.07	1.41-1.44
Student Self-Control (α = .716, AVE=.789, CR=.832)	.753-.814 (var=10.35%)	3.49-3.94	1.49-1.56
Student willingness to study Math (α = .919, AVE=.865, CR=.922)	.813-.897 (var=18.44%)	4.29-4.61	1.16-1.33

Note: KMO (0.900); Variance extracted (74.84%); Barlett's Test of Sphericity are all significant at p value < 0 .0005

In social sciences, where information is often less precise than in pure sciences, it is common to consider a solution that accounts for 60 percent of the total variance as satisfactory and providing practical significance for the derived factors by ensuring that they explain at least a specified amount of variance (Hair et al., 2010). In this study, these five factors account for 74.84 percent of the variance in the data, ensuring at least a specified amount of variance explained. Moreover, factor loading, composite reliability (CR), and average variance extracted (AVE) were used to establish convergent validity. The value ranges from 0 to 1. AVE should exceed 0.50 to present convergent validity. In this study, all the values mentioned exceed the threshold value, indicating convergent validity (Hair et al., 2010; Bagozzi & Yi, 1988) (see Table 2).

Discriminant validity refers to the extent to which factors are distinct and uncorrelated. The rule is that variables should relate more strongly to their own factor than to another factor. In this study, discriminant validity was analyzed following Fornell and Larcker (1981) by comparing the square root of each AVE in the diagonal (correlation to their own factor) with the correlation coefficients (off-diagonal) for each construct in the relevant rows and columns. Based on the above-mentioned rule, the correlation figure on off-diagonal should be lower than figures on diagonal to reflect the discriminant validity (see Table 3). Overall, discriminant validity can be accepted for these measures and supports the discriminant validity between the constructs.

Table 3: Discriminant Analysis

	Confidence	**Anxiety**	**Ability**	**Self-Control**	**Willingness**
Confidence	**.840**				
Anxiety	-.524**	**.890**			
Ability	.683**	-.554**	**.868**		

Self-Control	.002	.213**	-.043	**.888**	
Willingness	.553**	-.233**	.442**	-.108*	**.930**

Note: **correlation is significant at the 0.01 level (2-tailed). *correlation is significant at the 0.05 level (2-tailed). The value on the diagonal is square root AVE.

5. Results

A multiple regression analysis was applied using the composite score of each factor. As Table 4 indicates, the regression equation for each independent variable on willingness to study mathematics is valid, where F value = 70.680. Moreover, the Durbin-Watson value is 1.719, which is close to 2.0, indicating that there is no autocorrelation detected in the data set. The variance inflation factor (VIF) value of each independent variable ranges between 1.000-2.057, which are less than 4, indicating that there is no multicollinearity in a set of regression variables (Hair et al., 2010). Therefore, these independent variables are appropriate to include in the regression analysis. For adjusted R square value, 33.5 percent indicates that 33.5 percent of the variances in the dependent variable can be explained by the independent variables. An explanatory power of up to 33.5 percent indicates that they can be used to effectively predict student willingness to study mathematics. In summary, the multiple regression analysis is reliable and valid since all assumptions have been met.

Results of the regression analysis show that student confidence is highly significantly related to student willingness to study math ($\beta = 0.524$); H1a is supported. Student anxiety in math is significantly related to student willingness to study math ($\beta = 0.160$); H2a is supported. Moreover, student ability in math is significantly related to student willingness to study math ($\beta = 0.165$); H3a is supported. Lastly, student self-control is significantly related to student willingness to study math ($\beta = 0.136$); H4a is supported. In addition, results of the simple regression analysis show that student willingness is a highly significant predictor of student performance in math ($\beta = 0.243$); H5 is supported. In summary, based on the above-mentioned results, willingness is influenced by student confidence in math, followed by student ability in math, student anxiety in math, and student self-control. Therefore, students who have high confidence in math, have high ability in math, experience high levels of anxiety in math, and have a high level of self-control, are more likely to develop a willingness to study mathematics. More specifically, student willingness to study math certainly influences student performance in math.

Table 4: Hypotheses Testing Results (Indirect Effect)

Hypotheses	Standardized Coefficient	t value	p value	VIF	Results
H1a: Confidence □ Willingness	.524	10.639	.000	2.019	Support hypotheses
H2a: Anxiety □ Willingness	.160	3.638	.000	1.610	Support hypotheses

H3a: Ability Willingness	.165	3.316	.001	2.057	Support hypotheses
H4a: Self-Control Willingness	.136	3.800	.000	1.068	Support hypotheses
H5: Willingness Actual Behavior (willingness as mediator)	.243	5.852	.000	1.000	Support hypotheses

Note: Adjusted R square = 33.50%; F value = 70.680 at p value < .0005 for H1-H4; Durbin-Watson value = 1.719; R square = 5.7%; F value = 34.250 at p value < .0005 for H 5; Durbin-Watson value = 1.443

As can be seen in Table 5, the regression equation for each independent variable on student performance in math is valid (F value = 33.686). Moreover, both the Durbin-Watson value (1.383) and the variance inflation factor value of each independent variable (less than 4) indicate the absence of collinearity and the autocorrelation of residuals among the investigated independent variables. Therefore, these independent variables were appropriate to include in the regression analysis, and have an explanatory power of up to 23.0 percent, indicating that they can be used to effectively predict student performance in mathematics (actual behaviors). Results of the regression analysis show that only student ability and student anxiety are significantly related to student performance in math ($\beta = 0.232$ and $\beta = -0.261$, respectively); H2b and H3b are supported. However, student confidence in math and student self-control are not significantly related to student performance in math ($\beta = 0.036$ and $\beta = -0.016$, respectively); H1b and H4b are not supported. Lastly, student willingness to study math is not significantly related to student performance in math ($\beta = 0.060$); H5 is not supported.

In summary, as indicated by the above-mentioned results, whereas student performance is influenced by their ability in math as well as their anxiety in math, student confidence, self-control and willingness do not influence their performance in math. Therefore, students who have high ability in math are more likely to perform well in math and students who experience a high level of anxiety in math are less likely to perform well in math. However, for students who have high confidence in math and students who have high self-control, these characteristics have no effect on their performance in math. Student willingness to study math also has no effect on student performance in math. It is also important to note that student willingness to study math is a good predictor as a mediator but not as an independent variable.

Table 5: Hypotheses Testing Results (Direct Effect)

Hypotheses	**Standardized Coefficient**	**t value**	**p value**	**VIF**	**Results**
H1b: Confidence Actual Behavior	.039	.663	.508	2.424	**NS**
H2b: Anxiety Actual Behavior	-.261	-5.379	.000	1.670	Support hypotheses
H3b: Ability Actual Behavior	.232	4.269	.000	2.098	Support hypotheses

H4b: Self-Control □ Actual Behavior	-.016	-.400	.689	2.424	**NS**
H5: Willingness □ Actual Behavior (willingness as IV)	.060	1.309	.191	1.505	**NS**

Note: Adjusted R square = 23.0%; F value = 33.686 at p value < .0005 for H1-H4; Durbin-Watson value = 1.383

6. Discussion and Conclusion

Prior research and this study prove that the theory of planned behavior is an effective theory in predicting student behavior, including with regard to studying mathematics. Regarding the findings, with student willingness to study math as a dependent variable, the following comments can be made. The first finding (H1a), which indicates a relationship between student confidence and student willingness to study math, is consistent with the study of Parsons, Croft, and Harrison (2009) that focuses on first-year engineer students learning mathematics at university during the period 2005-2007. The second finding (H2a), which shows a relationship between student anxiety and student willingness to study math is in keeping with the conclusions of a study by Meece et al. (1990), in which a 250 sample of 7th- through 9th-grade students enrolled in a math course was examined. The third finding (H3a), which reveals a relationship between student ability and student willingness to study math confirms the findings made by Niepel et al. (2018) in their research study conducted in various US middle schools with the data collected in two waves (June and November 2012).

The fourth finding (H4a), which establishes a relationship between student self-control and student willingness to study math, is consistent with the determination made by Fauzi and Widjajanti (2018) in their desk research browsing the journal on the internet using the Mendeleye program. Moreover, the fifth finding (H5) with has willingness to study as the single independent variable, indicates that there is a relationship between student willingness to study math and actual performance. This finding is consistent with the results of a recent study by Aungatichart, Fukushige, and Aryupong (2020) that examines 400 Thai consumers of organic foods and confirms the predictive role of the theory of planned behavior. These findings, all in keeping with all the relevant literature on the theory of planned behavior (e.g. Lipnevich et al., 2011; Niepel et al., 2018; Oh, 2003) come in support of its effectiveness as a toll for predicting behaviors in the academic field and the study of math

The findings with student actual performance as the dependent variable call for the following comments. The conclusion that there is a negative relationship between student anxiety and student actual performance (H2b) is consistent with the findings of a study conducted by Vitasari et al. (2010) at the Universiti Malaysia Pahang (UMP). The study examines 205 second-year engineering students. The seventh finding that there is a relationship between student ability and actual performance (H3b) is in keeping with previous studies. For example, Caspi et al. (2006) conducted a web-based study to examine the competence of fourth-year medical students in the United States and found a strong correlation between ability and actual performance. Surprisingly, in this study of first year students at a private Thai university, no relationship between student confidence (H1b), student self-control (H4b), and student willingness to study (H5 as one of the five independent variable) with student actual performance has been found.

One interesting result is that student anxiety is positively related to student willingness to study math but negatively related to actual performance. This is consistent with previous studies, in particular one by Cassady (2004), who investigated 124 undergraduate students majoring in educational psychology at a Midwestern United States university and made the same determinations were made. One possible explanation for the positive relationship could be that the more they are afraid of math, the more they are willing to study as it is quite likely that in their opinion more knowledge can help reduce their anxiety. As to the negative relationship, one possible explanation may be that students' anxiety level could be so high, especially during exam periods, that it could have an adverse affect on their performance. Keeley, Zayac, and Correia (2008) studied 83 students enrolled in a single introductory statistics course during the spring of 2005 at a large university in the southeastern U.S. and also found that the relationship between student anxiety and performance was a curvilinear relationship.

Another interesting finding in this research is the relationship between student ability, willingness to study and actual performance. One way of accounting for it may be that student ability is determined by their skills, which means that when students believe in their own skills, it increases their willingness and spur them into their action. As to the fact that in this study student confidence is not related to actual performance, it may be due to students' overconfidence in this non-credit subject. They may simply not produce enough efforts taking the exam. This is also the case with student self-control. Since students are likely not to put much effort in this course, they cannot do well on the exam. In summary, it can be seen that the most important finding in this study is that student willingness to study math fully mediate the relationship between student confidence, student anxiety, student ability, and student self-control with their actual performance in math. It enhances the theory of planned behavior.

- *Implications*

This study aims to explore the relationship between the determinants of student willingness to study mathematics and the effect on their actual performance. Although some research have studied the determinants affecting actual performance (e.g. Mazana, et al., 2019; Mohd, et al., 2011), student willingness to study math has been neglected. The importance of student willingness to study mathematics is verified by the theory of planned behavior (Ajzen, 2002). Student willingness to study is a major factor in student academic success. This can be used to introduce programs for university students who want to develop their math learning skills. The findings of this study will help decision makers in higher learning institutions to gain a better understanding of the factors that determine student willingness to study mathematics. The promotion of student willingness to study by teachers will facilitate the development of learning competences (Tuckman & Kennedy, 2011). In addition, if students are more confident and less anxious and develop their ability and self-control, their performance will improve. This means taking steps to rearrange the curriculum and have proper learning facilities to assist students. This also means ensuring proper guidance and support by parents.

- *Limitations*

This study has limitations. Firstly, this study was conducted at only one private university about one subject and for one semester. Future studies should therefore consider including more universities and more courses for generalizable purposes. Secondly, although R square value is equaled to 38%, which is quite acceptable, some other determinants of academic performance are not discussed. Yet, they could improve the R square value. This includes self-motivation, family income, and parents' level of education. Recall from above that the square of the correlation (R square) measures the proportion of variation in the dependent variable that can be attributed to the independent variable. Thirdly, the research framework tested is a new combination of theoretically related variables in the context of developing countries (Thailand

is an upper middle-income developing country). Therefore, the findings of this study would be more generalizable if future studies focused on a number of other developing countries. Finally, since this study is a cross sectional research, it is not feasible to assess causality findings between the variables that were examined. It will thus be interesting in the future to have longitudinal studies that make it possible to examine causality.

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