Investigating International School Secondary students' Attitude towards Mathematics

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ABSTRACT

This study investigates factors that influence international school secondary students' attitude towards mathematics. A data was collected from 177 respondents studying in one international school in Sungai Buloh ranging between ages 11 - 16 years old by using an online questionnaire. The data were analysed descriptively and using *t*-test, one-way ANOVA, and multiple linear regressions with the help of the SPSS software. The result from the one-way ANOVA shows a significant difference among the range of age groups while there is no significant difference between gender and students' performance in mathematics based on the *t*-test. There is a positive correlation between the students' attitude and their performance in mathematics. The most attitude factor that contributes to the students' performance is self-efficacy. The findings provide a better view for educators, schools, and institutions to develop a better teaching and learning method to improve students' self-efficacy in the classroom.

Keywords: attitude, mathematics performance, International School.

ABSTRAK

Kajian ini mengkaji faktor-faktor yang mempengaruhi sikap pelajar sekolah menengah antarabangsa terhadap matematik. Data dikumpulkan daripada 177 responden yang belajar di sebuah sekolah antarabangsa di Sungai Buloh yang berumur antara 11 - 16 tahun dengan menggunakan borang soal selidik dalam talian. Data dianalisis secara deskriptif dan menggunakan uji-t, ANOVA sehala, dan regresi linear berganda dengan bantuan perisian SPSS. Hasil dari ANOVA sehala menunjukkan perbezaan yang signifikan antara kumpulan umur dan tidak terdapat perbezaan yang signifikan antara jantina dan prestasi pelajar dalam matematik berdasarkan ujian-t. Terdapat hubungan positif antara sikap pelajar dan prestasi mereka dalam matematik. Faktor sikap yang paling besar menyumbang kepada prestasi pelajar adalah swa-efikasi. Hasil kajian memberikan pandangan yang lebih baik bagi pendidik, sekolah, dan institusi untuk mengembangkan kaedah pengajaran dan pembelajaran yang lebih baik untuk meningkatkan efikasi kendiri pelajar di dalam kelas.

***Kata kunci**: Sikap, pencapaian matematik, Sekolah antarabangsa.*

INTRODUCTION

Mathematics is often perceived to be one of the most difficult subjects; a concept that is hard to comprehend or understand. Mathematics influences almost every sector in our present-time society. Possessing a reasonable understanding of mathematics can assist some students with real-life problems that they may face. However, researchers revealed that mathematics is believed to be the most difficult and challenging subject by many students (Ashaari *et al*., 2011; Nardi & Steward, 2003). In Malaysia for example, studies revealed that most students found mathematics is a difficult subject due to a lack of knowledge in the subject, its skills and concept methodology (Ashaari, *et al*., 2011). Seven attitude factors identified by Marchis (2011) are being discussed in this study to identify whether these factors influence the students' attitude towards learning: self-efficacy, self-judgement, seeking-help, self-reaction, mathematical anxiety, beliefs in utility of mathematics in real-life and teachers' involvement.

Some students have the ability to excel in mathematics, but they falsely believe that their lack of conceptual understanding in mathematics is the cause of their downfall in their performances (Beghetto & Baxter, 2012; Tambychik & Meerah, 2010). Students' belief in learning mathematics might possibly give an effect on their interest and incitement in mathematics. These beliefs show us how students perceive mathematics and look at it in a social learning context (Kele, 2014). These negative beliefs are the factors that contribute to the struggles they may face in learning mathematics which indirectly causes a major impact on their performances and mathematics results (Amirali, 2010; Whitin, 2007).

Students' performance in mathematics is highly influenced by their mathematical anxiety. Many studies have been carried out to investigate the correlation between mathematics achievement and mathematical anxiety (Mutawah, 2015; Pantaleon, 2018). From these studies, it has shown that math anxiety gives a negative impact on students' performance, mainly seen from standardized tests of mathematical performance, their results in mathematics, target to enrol in possibly high school with advanced mathematics courses and colleges offering math related majors (Tambychik & Meerah, 2010; Amirali, 2010; Kele, 2014; Nizam& Rosli 2021)

Self-efficacy is defined as one's belief in capability to organize and carry out actions to produce relevant outcomes (Bandura, 1997). Natural behaviour of humans is actuated by provident thought processes used in forward planning and the capability to choose the right courses of action. This process may be assisted by the capability perceptions; without the actual presence of it (Bandura, 1997; Zimmerman, 2008). According to Nizam& Rosli (2021), self-efficacy factors drive the ability of pupils to master something in the academic field. Activities that involve social interaction between male students and female students such as cooperative learning are well suited in the development of self -efficacy (Nizam& Rosli 2021).

Self-judgement is believed to be in positive correlation with mathematics' attitude. How students perceive and judge their ability to solve mathematical problems affects their belief towards mathematics. Students' self-judgement on their capability reflects on their academic performances. It is a key type of self-evaluation that compares students' goals with their learning outcomes (Andju *et al*., 2010).

It is a known fact that all students will encounter a mathematical problem that they cannot find a solution on their own. Help-seeking is studied to be an important strategy that will help students perform better when the tasks become difficult or when they are unable to complete it on their own (Karabenick & Berger, 2013; Zimmerman, 2008). Hence, help-seeking plays a crucial role in the success of mathematical learnings; students who are regular in seeking help produce higher mathematics results compared to those who hardly engage in self-regulated learning (Ryan & Shim, 2012; Ryan *et al*., 2009, Ahmad & Amirul, 2017).

Self-reaction is in positive correlation with mathematics' attitude. Self-reaction affects students' mathematical reasoning and their achievement in it. Quite a number of studies have shown that self-regulation has a positive impact with the academic achievements (Fadlelmula *et al*., 2015; Mousoulides & Philippou, 2005; Velayutham & Aldridge, 2013; Zimmerman, 2002). This statement is also mentioned by Winne (2000) and Zimmerman (2008), that self-reaction should give an improved performance.

Mathematics anxiety is in negative correlation with mathematics attitude. It is known that mathematics anxiety is a feeling of tension and nervousness with students' ability in solving mathematical problems (Khasawneh *et al*., 2021). There have been studies that mentioned that mathematics anxiety can affect students through cognitive, physical reaction or effectiveness. For example, cognitive reaction involves negative self-talk, physical reaction can be seen by perspiration and affective reaction may be by the fear of looking less smart (Freiberg, 2005) and all these reactions may lead to a long-lasting effect on the students while learning mathematics.

One major concern in learning mathematical education is, although mathematics is potentially useful in daily life, students choose to not believe that. Students' beliefs about learning mathematics are linked with their early mathematical skills (De Corte & Verschaffel, 2006; Marsh *et al*., 2005; Wigfield *et al*., 2015), which correlates with mathematics achievements (Duncan *et al*., 2007; Jordan *et al*., 2010; Watts *et al*., 2014).

Teachers' involvement may also influence students' attitude towards mathematics. A successful delivery of a lesson is a result of a teachers' impactful teaching style. Students' interest in mathematics may be increased due to the effectiveness of a lesson. They will be able to look at the conceptual understanding of mathematics questions better when a teacher conducts his/her lesson effectively (Naciappan et al. 2017). This shows a teachers' self-efficacy belief; the confidence of a teacher to bring out desired outcomes from students by motivation when students are struggling in mathematics (Moran & Hoy, 2007). According to Bandura (1997), a teachers' self-efficacy is the primary source of teaching behaviours and decisions.

Thus, this study aims to investigate the factors mentioned above that would influences students' attitude towards learning mathematics The findings and results from this study are aimed to benefit students, mathematics teachers, schools, founders of international schools in Malaysia and parents. The findings also would be beneficial for future use of teachers to find various methods that can be incorporated into their lesson in order to make the understanding of mathematics concepts and to increase their interest in this subject. Future school management may use these findings to modify their existing mathematics curriculum to fit the needs of their students. Their lessons may be catered to increase the student's positive attitude towards mathematics and at the same time develop their self-confidence in the subject. This may also help them improve on their teaching skills and work on strategies to improve the performance of the secondary school students.

OBJECTIVE

Specifically, the objective of this study is to investigate the factors that influence International School secondary students' attitude towards mathematics based on gender and three different age group. The study also investigates the correlation of students' attitude towards their performance in mathematics.

METHODOLOGY

A quantitative methods approach was used to collect data for this study. A total of 177 Secondary school students of ages between 11 to 16 years old from one International School in Sungai Buloh

were the respondents for this study. The demographic distribution of the respondents is as shown in Table 1.

Table 1: Demographic Variable of Respondents

Variable		Frequency	Percent
Gender			
	Male	63	35.6
	Female	114	64.4
Age			
	11 – 12 years	37	20.9
	13 - 14 years	91	51.4
	15 – 16 years	49	27.7
Race			
	Malay	10	5.6
	Indian	50	28.2
	Chinese	82	46.3
	Other	35	19.8

This study employed the questionnaire adapted from Marchis (2011) with 30 items divided into two section, 9 demographic and 21 items regarding attitude toward learning mathematics. The 21 items were categorized into seven attitude factors, and they are self-efficacy, seeking-help, self-judgement, self-reaction, mathematics anxiety, beliefs in utility of mathematics, and teachers' involvement. Each item is measured on a 5-point Likert scale from 1-strongly don't agree to 5-strongly agree. Overall reliability of questionnaire proved to be reliable at a consistency of 0.715 using the Cronbach's Alpha Test.

For the data collection process, questionnaires were distributed to the secondary school students by using an online platform, Google Form. The questionnaire was given to the secondary students by their respective mathematics teacher during their lesson and this process was done in a span of 2 weeks.

The data were analysed through descriptive analysis, inferential analysis and multiple linear regression analysis by using IBM SPSS Statistics version 28 and Microsoft-Excel. The mean score for each aspect of attitudes and the overall attitude were calculated for further analysis.

A *t*-test was conducted to find the significant difference between genders and students' attitude towards learning mathematics. While a One-way ANOVA was conducted to find the significant difference between age group and students' attitude towards learning mathematics. A Tukey post-hoc analysis was conducted to further discuss the significant difference between the age groups and students' attitude. Finally, a multiple linear regression analysis was conducted to determine the relationship and predict the students' performance based on the attitude factors; self-efficacy, seeking-help, self-judgement, self-reaction, mathematics anxiety, beliefs in utility of mathematics, and teachers' involvement. The performances of the students were represented by grade A, B, C, D, E, and F.

RESULTS

The result of mean and standard deviation of self-efficacy, seeking-help, self-judgement, self-reaction, mathematical anxiety, beliefs in utility of mathematics, and teachers' involvement was presented in Table 2.

Table 2: Descriptive statistics of attitude factors for age group

	11 – 12 years old		**13 – 14 years old**		**15 – 16 years old**	
N = 177	Mean	SD	Mean	SD	Mean	SD
Self-efficacy	3.42	0.706	3.00	0.991	2.91	0.887
Seeking- help	3.69	0.433	3.57	0.700	3.65	0.631
Self-judgement	4.10	0.514	3.86	0.637	3.82	0.700
Self-reaction	4.32	0.784	**4.31**	**0.740**	**4.35**	**0.772**
Mathematics Anxiety	3.15	0.656	3.06	0.899	3.48	1.010
Beliefs in Utility of Mathematics in Real-life	4.12	0.557	3.72	0.879	3.83	0.714
Teachers' Involvement	**4.51**	**0.426**	4.12	0.550	4.13	0.625
Attitude	**3.90**	**0.247**	**3.66**	**0.360**	**4.74**	**0.418**

The result shows the highest mean score attitude factors was teachers' involvement (M=4.51, SD=0.426) for students of age 11 - 12 years old. Whereas the students of age 13 - 14 years old and 15-16 years old, shows the highest mean score attitude factors was self-reaction (M=4.31, SD=0.740) and (M=4.35, SD=0.772) respectively. The result for the overall attitude indicates that students in the age group of 15 - 16 years old show a higher positive attitude towards learning mathematics compared to the age groups of 13 - 14 years old and 11 - 12 years old.

One-way ANOVA test was used to compare the students' attitude towards learning mathematics among the three age groups of students: 11-12 years old, 13-14 years old, and 15-16 years old. The result was shown as in Table 3.

Table 3: One-Way ANOVA test between students' attitude towards mathematics and age groups

Age Group	**N**	**Mean**	**SD**	**F**	***p*-value**
11 – 12	37	3.90	0.247	5.85	0.003
13 – 14	91	3.66	0.360		
15 – 16	49	3.74	0.418		

The result of one-way ANOVA analysis reveals that there was a significant difference between the students' attitude towards learning mathematics among the three groups of ages ($F(2,174) = 5.851, p < 0.05$). A Tukey post-hoc test was done and as a result, there was a statistically significant difference in the age group of 11 - 12 years old (M=3.90, SD=0.247) and 13 - 14 years old (M=3.66, SD=0.360) and 15-16 years old (M=3.74, SD=0.418). However, the results showed that there was no significant difference between group age 13 - 14 years old and 15 - 16 years old ($p > 0.05$).

Table 4 shows a result of an independent *t*-test that conducted to compare the students' attitude towards learning mathematics between female and male students. The result shows that there was no significant difference between the genders and students' attitude towards learning mathematics ($t(175)=1.4.138$, $p < 0.05$). Thus, there is no different in mean score students' attitude in learning mathematics between male and female students. Several studies done in the past have indicated that there isn't a conclusive study between gender differences towards learning mathematics as there are many other factors contributing towards students' achievement in the subject (Amirali, 2010; Ryan et al. 2012; Nardi & Steward, 2003).

Table 4: Independent *t*-test of students' attitude towards mathematics between genders

Gender	N	Mean	SD	*t*	*p*-value
Male	63	3.79	0.327	1.438	0.152
Female	114	3.71	0.387		

Next, Table 5 shows the result for a multiple linear regression analysis that conducted to predict the students' performance based on their mathematics grade with the seven factors that influence students' attitude towards learning mathematics. In this study, the multiple regression model was obtained using the stepwise method. The Stepwise method is a multiple regression method that suggested several models. Next, the most appropriate model for the study was selected by considering the important factors. Table 5 shows that the model with self-efficacy factor were statistically significant, $F(1,175) = 8.766, p = 0.003 < 0.05$. The adjusted R^2 value was 0.042, and this indicates that only 4.2% of the students' performance can be predicted from the self-efficacy factors. Although there only 4.2% association of the factor, the model still indicates a real relationship (Martin, 2012) between the students' performance and the attitude factors. The study reveals that self-efficacy contributes 33% in the performance of the students in mathematics. Therefore, self-efficacy significantly predicts the performance of the students and gives a positive impact on the secondary school students' performance in mathematics. This result gives support to the finding conducted by Marchis (2011), where there is a strong correlation between students' self-efficacy and their attitude to mathematics.

Table 5: Multiple Linear Regressions between Attitude and performance

	B	*p-value*	Note
Constant	3.60	0.000	
Self-Efficacy	0.33	0.003	***included*
Seeking-help	0.02	0.766	**excluded*
Self-Judgement	0.10	0.227	**excluded*
Self-Reaction	-0.02	0.746	**excluded*
Mathematics Anxiety	0.01	0.861	**excluded*
Beliefs in Utility of Mathematics	-0.15	0.319	**excluded*
Teachers' Involvement	-0.05	0.519	**excluded*
Note: $\boldsymbol{R = 0.218}$; $\boldsymbol{R^2 = 0.048}$; *adjusted* $\boldsymbol{R^2 = 0.042}$; $\boldsymbol{F(1,175) = 8.766}$, $\boldsymbol{p = 0.003 < 0.05}$			

DISCUSSION

This study investigated the factors that influence International School secondary students' attitude towards mathematics based on gender and three different age group. The result showed that students of the age range from 11 - 16 years old have shown a positive attitude in learning mathematics with the highest positive attitude shown by students between the ages of 15 - 16 years old. The findings reveal that as students get older, their perspective on learning mathematics increases. As students get older, the correlation between age and mathematics performance tend to rise (Mousoulides & Philippou 2005; Marchis 2011; Mutawawah 2015).

The findings of the study also showed that gender does not influence the students' attitude towards learning mathematics, but the different age groups did. Hence, age factor may be an issue that impacts students' attitude towards learning mathematics. Indeed, to cultivate a positive attitude towards mathematics, it would be best if we can get involved our children as early as possible. Since kids have so much fun playing, introducing game-based learning is a promising option for them to improve their attitudes toward mathematics. Students with a higher perception of the learning environment have more positive attitudes toward mathematics (Jordan et al. 2010). In fact, many studies point to a positive correlation between student attitude toward mathematics and student academic achievement (Mousoulides & Philippou 2005; Amirali, 2010; Marchis 2011; Watt et al. 2014; Mutawah, 2015;

Pantaleon, 2018) could give advantages to achieve higher performance and may result in more favourable attitudes such as self-efficacy, self-confident, enjoyment, motivation and interest.

This study also investigates the correlation of students' attitude towards their performance in mathematics as well as identify whether the factors: self-efficacy, self-judgement, seeking-help, self-reaction, mathematical anxiety, beliefs in utility of mathematics in real-life and teachers' involvement would influence the students' attitude towards mathematics. Activities that involve social interaction between male students and female students such as cooperative learning are well suited in the development of self -efficacy (Nizam& Rosli 2021). The study reveals that students' attitude towards mathematics also affects their performance in the subject. Among the seven attitude factors, self-efficacy significantly predicts the performance of the students and gives a positive impact on the students' performance in mathematics. The result of this correlation explains that the higher the self-efficacy, the higher the mathematics performance and vice versa, the lower performance self-efficacy, the lower the mathematics performance. Students with high self-efficacy are convinced that they can rely on their abilities through high mathematical performance. It is important for students to make them constant to try to do the given task, even though the task is not easy. The positive relationship between the self-efficacy and mathematics performance in this study are in line with the result of previous studies (Mousoulides & Philippou 2005; Grigg et al. 2018; Putri & Prabawanto 2019; Negara et al. 2020; Nizam& Rosli 2021).

CONCLUSIONS

Since our findings confirm that students' attitudes are deeply related to their performance, we believe that developing strategies in educational contexts, to improve teacher support and student engagement could be of vital importance in improving not only attitudes but also mathematical performance among students throughout their schooling. Teachers play an important part in instilling the interest of mathematics. Perhaps, teachers should be able to equip themselves with varieties of methods of teaching to keep their lessons engaged and interesting, indirectly changing their students' attitude towards mathematics. Teachers need to learn and know their students, their culture and background before a context is picked for teaching mathematics. As a result, class can be place more attractive and some contributions to improve the attitudes towards mathematics can be achieved in a positive way. Moreover, for better improvement, the school, and parents should be together in encouraging students in their learning. Bringing together school and family communities into one may be beneficial to student's achievement and student's attitudes toward mathematics. Hence, school managements should send their teachers to Continuous Professional Developments (CPD) to enhance their teaching methodology from time to time. CPDs with their colleagues will give teachers the opportunity to share and discuss ideas to enhance their teaching styles. Additionally, involving parents in their child's mathematics education may hearten in student's attitudes toward mathematics. It is important to open communication between parents and teachers and allow parents to learn specific strategies or activities to help their child with mathematic at home. By fostering a good parental attitude towards mathematics education, parent can be a more positive influence about their child's mathematical attitude, which can improve student achievement and interest in mathematics. As conclusion, these findings provide a better view for educators, schools, and institutions to develop a better teaching and learning method to improve students' attitude and achievement in learning mathematics.

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