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Mathematics Motivation in Developing Countries: A Vietnamese Case Study

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Abstract: Mathematics motivation plays a significant role in improving mathematics education. However, there is a lack of study on the perception of Vietnamese high school postgraduate students towards mathematics motivation. This paper aims to fill this gap by examining the attitude of both male and female high school graduate students on mathematics motivation as well as comparing mathematics achievement based on gender in Vietnam. The study utilised the Academic Motivation Toward Mathematics Scale (AMTMS) for the questionnaire survey and data collection. The findings showed that there was a non-significantly difference between the male and female perception of mathematics motivation. There was also a non-significant difference between male and female in mathematics achievement. The paper also discusses incorporating technology in mathematics education to promote educators and students in teaching and learning mathematics.

Keywords: Mathematics education, mathematics motivation, gender difference, mathematics achievement.

1. Introduction

The studies of mathematics education and affected domain have been received attention from scholars and educators (Attard, Ingram, Forgasz, Leder, & Grootenboer, 2016). Individuals' emotions, beliefs and attitudes have been proved as a critical role in people's interest and response, in general, to mathematics and their employment of mathematics in their individual lives (OECD, 2013). A student who feels more confident with mathematics is more likely than others in using mathematics in the diverse contexts that they may experience (OECD, 2013). Also, a student who has positive emotions towards mathematics is participating better in learning mathematics than an individual who feels anxiety (OECD, 2013). Consequently, one of the main objectives of mathematics education is to develop students' emotions, beliefs and attitudes in supporting them more likely to apply the mathematics and learn more mathematics for their individual and social benefits (OECD, 2013).

In mathematics education research, the study of engagement and motivation seems to be a growing area of interest (Attard et al., 2016). Lim and Chapman (2015a) adapted the academic motivation scale (AMS) (Vallerand et al., 1992) to develop the academic motivation toward mathematics scale (AMTMS).

The academic motivation can be classified into three categories based on the self-determination theory, including amotivation, extrinsic motivation and intrinsic motivation (E. L. Deci & Ryan, 1985). Amotivation refers to the absence of intent to pursue an activity because an individual does not value an activity, feel incompetent or feel unable to obtain a desirable outcome (Edward L. Deci & Ryan, 2000). Intrinsic motivation refers to pursue an action due to its satisfactions (Edward L. Deci & Ryan, 2000) and it can be referred to the scenario that people participate in activities for the pleasure and satisfaction that are obtained in the engagement process (Lim & Chapman, 2015b). Extrinsic motivation, however, includes the cline between amotivation and intrinsic motivation, including external regulation, introjected regulation, and identified regulation (Edward L. Deci & Ryan, 2000).

External regulation can be seen as a form of extrinsic motivation in which individual behaves to achieve the desired outcomes, for instance, avoiding a threat of punishment or tangible rewards (Edward L. Deci & Ryan, 2000). Introjection can be seen as a more internal form of extrinsic motivation than external regulation, and it occurs when people feel that they 'ought to' engage in activities (Lim & Chapman, 2015b; Wang, Hagger, & Liu, 2009). In comparison to external regulation that has poor maintenance and transfer, an introjection has been partly internalised and consequently more likely to maintain over time; however, they stay a relatively unstable (Edward L. Deci & Ryan, 2000; Koestner, Losier, Vallerand, & Carducci, 1996). Identification can be seen as the most internal form of extrinsic motivation (Lim & Chapman, 2015b). It does not involve in identifying the importance of behaviours but also to integrating those identifications with other aspects of the self (Edward L. Deci & Ryan, 2000).

Regarding mathematics motivation, several studies examined the relationships between mathematics motivation and mathematics achievement. Motivation has been notified to positively associate with a desirable outcome, such as high academic performance in education (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007). However, the lack of academic motivation negatively affects education outcomes (Barkoukis, Tsorbatzoudis, Grouios, & Sideridis, 2008). Amotivation is related to a large number of highly negative outcomes (Edward L. Deci & Ryan, 2000). Lim and Chapman (2015b) found out that amotivation and intrinsic motivation statistically associate with mathematics achievement for both male and female students who enrolled in a top pre-tertiary institution in Singapore. Also, intrinsic motivation has been proved to be the most significant affective domain for females in achieving better mathematics performance in the long term (Lim & Chapman, 2015b). Moreover, identification positively affects mathematics achievement (Lim & Chapman, 2015a). However, as noted by Lim and Chapman (2015b) their findings were based on Chinese sample in Singapore, further studies on students from other countries and cultures are necessary.

Furthermore, gender differences are still a concern in mathematics education. There was a concern regarding an under-representation of a female in the Science Technology, Engineering, and Mathematics (STEM) fields as well as year 12 mathematics in advanced and intermediate levels (Attard et al., 2016). Also, gender differences were found in the study of the relationship between mathematics motivation and mathematics achievement (Lim & Chapman, 2015b).

Through identifying the affective domains in mathematics education, educators, especially mathematics teachers, may apply different intervention methods assisting students in improving their self-confidence in mathematics. Thus, this may lead to improve mathematics achievement. However, there is a lack of empirical research into the perception of students on mathematics motivation and performance considering the gender, especially in Vietnam. Therefore, this paper aim is to fill this gap by examining the attitude of both male and female high school postgraduate students on mathematics motivation as well as comparing the mathematics achievement based on the gender in the Vietnamese context.

2. Research Methodology

Section 2 presents an overview of the sample size, data collection instrument, and data analysis method.

2.1 Participants

The target respondents were high school postgraduate students who participated in the National High School Graduation Examination, 2019. The exam was administrated by the Ministry of Education and Training at the end of year 12 to get a High School Graduation Certificate. The results of the exam were also used to apply for further studies, such as college or university. There were 305 males, 367 females and 8 others in the final sample (N = 680). Among participants, 93.8% of them have been studying a higher education, in which, 92.2% enrolled in a University. Interestingly, 85.9% of participants who have reported that they used their mathematics scores in their combination subjects to apply for studying at university. In Vietnam, universities often used scores of several subjects in the National Examination to select students.

2.2 Data Collection Instrument

The study utilised the Academic Motivation Toward Mathematics Scale (AMTMS) (Lim & Chapman, 2015a). The AMTMS was developed based on the academic motivation scale (AMS) (Vallerand & Blssonnette, 1992) which is one of the most commonly adopted instruments for measuring academic motivation (Lim & Chapman, 2015b). The AMTMS includes amotivation (AMOT) (four items), external regulation (EMER) (four items), introjection (EMIN) (four items), identification (EMIT) and intrinsic motivation to accomplish (IMTA) (5 items) (Table 1). All these items were used as the answers to the AMTMS's main question - Why do you spend time studying mathematics? The participants were asked to give their opinions on these items according to a 5-point response scale ranging from 1 (strongly disagree) to 5 (strongly agree). Table 1 presents the measurement items as well as its mean and standard deviation.

Table 1. *The Academic Motivation Toward Mathematics Scale (Lim & Chapman, 2015a)*

Variable	Mean	SE	SD
Why do you spending time studying mathematics			
notivation	*Cronbach's Alpha: 0.859*		
Honestly, I don't know; I feel that it is a waste of time studying mathematics.	1.76	0.032	0.840
I can't see why I study mathematics and frankly, I couldn't care less.	1.90	0.033	0.858
I don't know; I can't understand what I am doing in mathematics.	1.92	0.033	0.856
I am not sure; I don't see how mathematics is of value to me.	1.88	0.033	0.854
:ternal regulation	*Cronbach's Alpha: 0.872*		
Because without a good grade in mathematics, I will not be able to find a high-paying job later on.	2.96	0.042	1.085
In order to obtain a more prestigious job later on.	3.28	0.037	0.960
Because I want to have "the good life" later on.	3.62	0.036	0.937
In order to have a better salary later on.	3.54	0.037	0.953
rojected regulation Cronbach's Alpha: 0.810			
Because of the fact that when I do well in mathematics, I feel important.	3.89	0.030	0.789
Because I want to show to others (e.g., teachers, family, friends) that I can do mathematics.	3.67	0.034	0.882
To show myself that I am an intelligent person.	3.38	0.037	0.957
Because I want to show myself that I can do well in mathematics.	3.49	0.034	0.880
:ntified regulation	*Cronbach’s Alpha: 0.890*		
Because I think that mathematics will help me better prepare for my future career.	3.76	0.034	0.887
Because studying mathematics will be useful for me in the future.	3.91	0.032	0.828
Because I believe that mathematics will improve my work competence.	3.95	0.032	0.831
Because what I learn in mathematics now will be useful for the course of my choice in university.	3.68	0.035	0.902
ıotivation	*Cronbach's Alpha: 0.908*		

Variable	Mean	SE	SD
Because I want to feel the personal satisfaction of understanding mathematics.	4.09	0.031	0.804
For the pleasure I experience when I discover new things in mathematics that I have never learnt before.	4.04	0.030	0.791
For the pleasure that I experience in broadening my knowledge about mathematics.	4.01	0.031	0.808
For the pleasure that I experience when I learn how things in life work, because of mathematics.	3.85	0.033	0.856
For the pleasure that I experience when I feel completely absorbed by what mathematicians have come up with.	3.58	0.035	0.921
Mathematic score in the National High School Graduation Examination, 2019	7.28	0.051	1.343

2.3 Data Analysis Method

The study used SPSS for data analysis. Descriptive statistic was used to examine the mean values, standard errors (SE) and standard deviations (SD). Reliability analysis was conducted to assess internal consistency. One-way ANOVA was conducted to see whether there is a significant difference in perception between male and female on measurement items as well as mathematics achievement. Cronbach's alpha values of measurement scales are from 0.810 to 0.908 (Table 1), which is considered very good or excellent (Kline, 2015). Therefore, the measurement scales appear to consist of a set of consistent variables for observing the meaning of the measurement constructs.

3. Results and Discussion

This section presents the preliminary findings of the study, comparative analysis based on the gender about the perceptions regarding mathematics motivation, and discussion about applying technologies in mathematics education.

3.1 Preliminary Finding

This section examines and interprets the mean values of all measurement items calculated from the whole sample.

As shown in Table 1, the amotivation measurement items had mean values of around (1.76 – 1.92), which were significantly lower than 3.0 (neutral point), AMOT1 $[t(679) = -38.403, p < 0.001]$, AMOT2 $[t(679) = -33.351, p < 0.001]$, AMOT3 $[t(679) = -32.997, p < 0.001]$ and AMOT4 $[t(679) = -34.292, p < 0.001]$. These data indicated that the respondents strongly disagree with the statements regarding amotivation measurement items when answering the main question. The statements are a waste of time studying mathematics (AMOT1), cannot see why I study mathematics (AMOT2), cannot understand what I am doing in mathematics, and do not see how mathematics is of value (AMOT3).

Overall, the mean values of external regulation items compared with 3.0 (neutral point) were mixed. The mean value of EMER1 (2.96) $[t(679) = -0.990, p = 0.323]$ was around 3.0, which represented 'neutral point', and indicated that most students did not agree or disagree to the statement that without a good grade in mathematics, they will not be able to find a high-paying job later. However, the mean values of EMER2 (3.28), EMER2 (3.62) and EMER4 (3.54) $[t(679) = 7.632 ?? 17.271, p < 0.001]$ were above the medium level of 3.0, indicating that students spending time to study mathematics because they want to obtain a more prestigious job (EMER2), 'the good life' (EMER3) and better salary

(EMER4).

Regarding introjection measurement items, EMIN, the mean values (3.49 ? ? 3.89) were all above the medium level of 3.0, $[t(679) = 10.298 ?? 29.404, p < 0.001]$. It indicates that students strongly believed that their feeling of studying mathematics had been motivated them. For instance, these include feeling important when doing well in mathematics (EMIN1), showing others that they can do math (EMIN2) as well as showing themselves as an intelligent person (EMIN3) and showing that they can do well in math (EMIN4).

In terms of identification, EMIT, the mean values (3.68 ? ? 3.91) were significantly higher than 3.0 $[t(679) = 19.648 ?? 29.755, p < 0.001]$. It means that most students strongly agreed that they were studying mathematics with the belief about the benefits that mathematics may offer. They include a better preparing for their future career (EMIT1), useful in the future (EMID2), improving their work competence (EMID3) and useful for their future study (EMID4).

Regarding intrinsic motivation, IMTA, the mean values (3.58 ? ? 4.09) were significantly higher than 3.0 $[t(679) = 16.453 ?? 35.429, p < 0.001]$. It suggests that the pleasure and satisfaction were also a motivation for students to study mathematics, such as feeling the personal satisfaction of understanding mathematics (IMTA4) and for pleasure (IMTK2, IMTK3, IMTS2 and IMTS3).

In this study, the average mathematics score of respondents was relatively high, 7.28 out of 10 (see Table 1). The demographic information can explain this finding. According to the survey, 93.8% of participants have studied at university. 85.9% of respondents used mathematics score in their combination of subjects to apply for studying at university. Thus, it can be assumed that mathematics was a primarily focused subject for those students as they needed a good mark to be able to get in their preference's university.

3.2 Comparison of Male and Female Samples

In addition to the initial results presented in the last section, this paper also undertook a comparative analysis based on the gender about the perceptions regarding mathematics motivation measurement items as well as the mathematics achievement of male and female.

To determine whether there was any difference in the perception of the mathematics motivation items as well as the mathematics achievement regarding gender, one-way ANOVA was conducted. In ANOVA, the F-ratio is considered as an essential test statistic indicator (Allen, Bennett, & Heritage, 2014). There is a statistically significant difference between the groups being compared when the F-ratio is statistically significant. Besides, the effect size is an essential test statistic (Allen et al., 2014). In this paper, the authors used the eta-squared ($??^2$) which is an index of the omnibus effect size. Eta-squared ($??^2$) is computed by dividing the $SS_{Between}$ (between-group sum of squares) by the SS_{Total} (total sum of squares) (Allen et al., 2014). It should be noted that when $??^2 = 0.01$ can be considered small, $??^2 = 0.059$ can be considered medium and $??^2 = 0.138$ can be considered large (Cohen, 1988). The results of the one-way ANOVA are presented in Table 2.

As presented, six variables had a statistically significant F-ratio (EMER3, EMER4, EMIN4, IMTA4, IMTK2, and IMTK3). The results suggest that, initially, the difference in the mean values of those variables was significantly different between the two groups. However, among those variables, all of those had small ($??^2 < 0.01$) or medium ($??^2 < 0.059$) effect size. Therefore, it can be concluded that there was a non-significantly difference between male and female perceptions of mathematic motivation. Furthermore, as illustrated in Table 2, there was a non-significant difference between male and female in mathematic achievement $F(1, 670) = 0.47, p = 0.829, ??^2 = 0.000$. This finding was slightly different to that of Attard et al. (2016) who concerned about under-representation of a female in the STEM and year 12 intermediate and advanced mathematics. This difference may be explained by the fact that, in Vietnam, mathematics can be seen as one of the most important subjects at school. Parents, caregivers, and teachers often encourage all students to study and spend more time in mathematics. Another explanation may be that most of the respondents in this study reported that their mathematics scores were used as a criterion to be selected for studying at university. So, mathematics was a primarily focused subject while they were studying at high school.

Table 2. *One-way ANOVA Results*

Variable	*F*	Sig.	Mean		Δ Mean	? ?²
			Male	Female		
AMOT1	3.124	0.078	1.81	1.70	0.11	0.005
AMOT2	2.949	0.086	1.96	1.84	0.12	0.004
AMOT3	0.702	0.402	1.94	1.89	0.05	0.001
AMOT4	1.644	0.200	1.92	1.83	0.09	0.002
EMER1	0.701	0.403	2.92	2.99	-0.07	0.001
EMER2	5.178	0.023	3.20	3.37	-0.17	0.008
EMER3	9.013	0.003*	3.50	3.72	-0.22	0.013
EMER4	6.322	0.012*	3.44	3.62	-0.18	0.009
EMID1	1.994	0.158	3.72	3.81	-0.09	0.003
EMID2	2.402	0.122	3.62	3.73	-0.11	0.004
EMID3	0.001	0.971	3.34	3.42	-0.08	0.000
EMID4	0.449	0.503	3.66	3.71	-0.05	0.001
EMIN1	0.053	0.819	3.89	3.90	-0.01	0.000
EMIN2	2.522	0.113	3.62	3.73	-0.11	0.004
EMIN3	0.956	0.329	3.34	3.42	-0.08	0.001
EMIN4	5.068	0.025*	3.42	3.57	-0.15	0.008
IMTA4	12.106	0.001*	3.99	4.20	-0.21	0.018
IMTK2	7.315	0.007*	3.96	4.13	-0.17	0.011
IMTK3	9.330	0.002*	3.92	4.11	-0.19	0.014
IMTS2	1.082	0.299	3.82	3.89	-0.07	0.002
IMTS3	0.000	0.988	3.59	3.59	0	0.000
MA	0.047	0.829	7.28	7.30	-0.02	0.000

3.3 Effective Technology Use to Improve Mathematics Engagement

Applying technology in mathematics education allows teachers and students to collaborate for improving learning experience that supports flexible thinking and problem-solving. With the development of technology and the Internet, websites and apps that provide manipulative options, for instance, geoboards, number frames, and number lines should be developed and used to support students to understand the mathematics concepts. Also, websites and virtual whiteboards can promote self-reflection for students; thus, these technologies may allow students making their learning visible and sharing and connecting ideas. Furthermore, virtual reality can be applied in mathematics education to help students to see three-dimensions (3D) geometry. These technologies, as mentioned earlier, can support educators in teaching and encourage students to effectively develop their problem solving skills while studying mathematics.

4. Conclusion

This study explored the perception of high school graduate students based on Academic Motivation Toward Mathematics in Vietnam. The study also looked at the gender difference toward mathematics motivation as well as mathematics achievement. The preliminary finding revealed that most of the respondents have studied at a University (92.2%) after graduated high school. Moreover, 85.9% of participants reported that they used their mathematics scores, together with scores of other subjects to apply for further study at university.

Furthermore, most respondents thought that studying mathematics is not a waste of time, and they understand what they did in mathematics as well as the values that mathematics may bring to their personal life. Students studied mathematics as they want to get a more prestigious job, good life and a better salary in the future. They also believed that their personal feeling of studying mathematics had been motivated them, for instance, feeling important when doing well in mathematics, showing others that they can do mathematics and showing themselves as an intelligent person. Notably, participants believe that studying mathematics could be better for their future study and career. Moreover, students reported that the pleasure and satisfaction were also a motivation for students to study mathematics. Besides, through one-way ANOVA analysis, there was a non-significantly difference between the male and female perception of mathematics motivation. There was also a non-significant difference between male and female in mathematics achievement.

There was a limitation on this study. Initially, the study did not target any particular group of respondents; anyone who participated in the National High School Graduation Examination, 2019 were welcome. However, the result reported that most of the respondents have studied at a University. So, the finding may only be represented by this particular group and may not be generalised to all high school graduate students in Vietnam.

The further studies may look at different affective domains and its relationship with mathematics achievement for high school students as well as the intervention strategies to improve mathematics education for high school students. With the development of technology, future studies may investigate the effectiveness of incorporating technology in mathematics education.

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