EXPLORING MOTIVATION TO LEARN MATHEMATICS THROUGH VROOM'S THEORY

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Abstract:

Mathematics is one of the fundamental subjects that contributes to Science, Technology, Engineering and Mathematics (STEM) careers since it plays a vital role in this Fourth Industrial Revolution. Due to that, this subject has been added in syllabus starting from primary school until university level and most of the students are taking mathematics but not limited to the students who are in the STEM area only. However, not all students particularly favour this subject since it requires problem solving skills as well as motivation to learn the subject matter. Therefore, the objective of this study was to investigate students' motivation in learning Mathematics through Vrooms' Theory. Quantitative method was used by distributing a set of questionnaires to 234 students in a public university in Malaysia. The instrument from the questionnaire consisted of three

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sections, a) affective components, b) expectancy components and c) value components with a total of 24 items. The findings revealed that students face anxiety while learning Mathematics and it could be motivating factors for the student to work even harder to perform in Mathematics. It was shown that their motivation towards learning Mathematics was influenced by how much value they placed on the outcome of the learning. This study can help educators to have a better understanding of students' learning motivation and provide continuous support to students.

Keywords: motivation; mathematics; learning; Vroom's theory

1. Introduction

1.1 Background of Study
Recently there has been renewed interest in learning mathematics (Rozgonjuk, Kraav, Mikkor, Orav-Puurand, Taht, 2020) and considerable literature has grown up around this theme. However, to better understand motivation to learn, Koca (2016) classified it as gaining the ability through continuous modelling, feedback on expectations and clear instruction. This definition is similar to that found in Middleton and Perks (2014) who writes: the learner being willing to the commitment of learning and creating strategies to encourage the learning process. It is now understood that motivation to learn mathematics plays an important role in changing the perceived perception on this subject. Clearly, learning mathematics may be associated with tough and hardship (Li and Schoenfeld, 2019). What stands out in this, the importance in researching motivation to learn mathematics subject has been given consideration in various research (Rozgonjuk et al., 2020, Koca, 2016, Li et al., 2019).

Malaysia Education Blueprint (2013-2025) underpin the significance of mathematics in the development of science and technology. On the other hand, the findings from the Blueprint report justified there was a correlation between the students' performance in the mathematics subject with their confidence level. This interpretation is different from Rozgonjuk et al. (2020) stressed on the perception of learning mathematics as a difficult subject and yet this subject also possesses high value for future career. This justified the need to measure the level of affective, expectancy and value of motivation in learning Mathematics through Vroom's Theory.

1.2 Statement of Problem
While a great value has been added in the development of Science, Technology, Engineering and Mathematics (STEM) in Malaysian Education Blueprint, the crucial part of this progress is to increase the awareness on the importance of learning Mathematics. The motivation to learn mathematics will benchmark the significance (Koca, 2016). Motivation to learn Mathematics leads to better understanding in the problem solving skills thus creating an area of improvement of nurturing students to learn (Middleton et al., 2014). The motivation is measured by three main domains in Vroom's Theory (Vroom,

1964) such as affective, expectancy and value. Therefore, all these domains in Vroom's Theory contribute to the needs of students' effort leading to their performance in learning the subjects (expectancy), the students' feedback on rewards (valence) and the students' belief in achieving the rewards (instrumentality).

Kiemer, Groschner, Pehmer and Seidel (2015) concern on students' interest in learning mathematics has to be the main purpose of educational plan. Hence, to stimulate the learning process, Kiemer et al. (2015) defines the quality of the motivation to determine the most favorable learning outcomes. In Yeh, Charles, Cheng, Chen, Liao and Chan (2019) studies, they stressed that the low performance in mathematics was perceived as low motivation as well. Thus, the incapability of motivating students, they design educational games to engage the learning progress in mathematics.

Hence, this study is done to investigate how learner' motivation to learn Mathematics is portrayed through Vroom's theory. This study is done to answer the following questions;

1.3 Objective and Research Questions

1) How can affective motivation in learning Mathematics be portrayed in terms of expectancy motivation?
2) How does expectancy motivation in learning Mathematics be portrayed in terms of Instrumentality?
3) How does value motivation in learning Mathematics be portrayed in terms of Valence?

2. Literature Review

2.1 Introduction

This section presents some demotivating and motivating factors for learners' motivation to learn Mathematics. This section also looks at some past studies related to learners' motivation in learning Mathematics and ends with the presentation of the conceptual framework designed for the study.

2.2 What Demotivates Learners in Mathematics

There are few factors that have been discovered as the reasons that demotivates learners to learn Mathematics. Two main factors are found which are students' low interest in the subject (Klepp, 1999 as cited in Yeh, Cheng, Cjen, Liao and Chan, 2019) and students having mathematics anxiety (Rozgonjuk, Kraav, Mikkor, Puurand and Taht, 2020).

The way a teacher teaches in class affects the students' interest in the subject taught (Yeh et al., 2019). In this kind of class, students are obligated to learn from the teacher at the same pace disregarding their own ability to absorb the content. Therefore, they are forced to receive the knowledge passively and become low achieving students. To overcome this situation, it is important for students to have more opportunities to learn at their own pace and ability.

Mathematics anxiety is described as experiencing feelings of panic and helplessness when a student is asked to solve a mathematical problem (Tobias & Weissbrod 1980 as cited in Rozgonjuk et al., 2020). This is found to be a common problem for students at elementary and tertiary school (Ashcraft & Moore, 2009; Luttenberger, Wimmer, & Paechter, 2018; Yamani, Almala, Elbedour, Woodson, & Reed, 2018 as cited in Rozgonjuk et al., 2020). There are few conditions that trigger mathematical anxiety such as from unpleasant teaching and assigning Mathematics as punishment for the students (Ashcraft & Moore, 2009, and Oberlin, 1982 as cited in Rozgonjuk, 2020).

In conclusion, learners become unmotivated to learn Mathematics because they do not have the interest in Mathematics and have anxiety when they are facing the subject

2.3 What Motivates Learners in Mathematics

There are several reasons why learners are motivated to learn Mathematics. The study carried out by Vaara, Rantakaulio and Eskol (2021) among 137 first-year Mathematics course students in Finland university reported that the students feel that learning the subject was meaningful and they have personal interest in the subject. In addition, the learners feel that Mathematics plays a significant role in the learners' further studies. Similarly, research administered by Syyeda (2019) revealed that adult learners in the United Kingdom were motivated to learn English and Mathematics offered by the government as the two subjects were important in the digital world. During their schooling years, the learners` Mathematics skills were not fully developed. However, they were given a second chance to improve their performance on both subjects for free during their adult years. It was reported that the learners were motivated by semi-skilled jobs and the increase in income if they succeed. As mentioned in the previous research, Mathematics plays an important role in professional development and further education. Research carried out by Sindoi (2020) among 602 secondary school students in Sarawak, Malaysia demonstrated that the students are motivated by the dimensions of the control of learning beliefs. Thus, students believe that their own efforts and hard work will contribute to the success instead of external factors such as teachers' efforts or fate. This belief will lead the students to strive strategically and effectively in order to succeed.

2.4 Motivation Theories

Figure 1 presents Vroom's (1964) motivation theory. Vroom (1964) presented three components in his theory. Expectancy is the learners' belief that his/her effort leads to the intended performance goals. This expectancy is dependent on the learners' instrumentality which refers to the learners' belief that he/she will receive a desired outcome if the performance expectation is met. Finally, valence is the unique value that the learners place on a particular outcome.
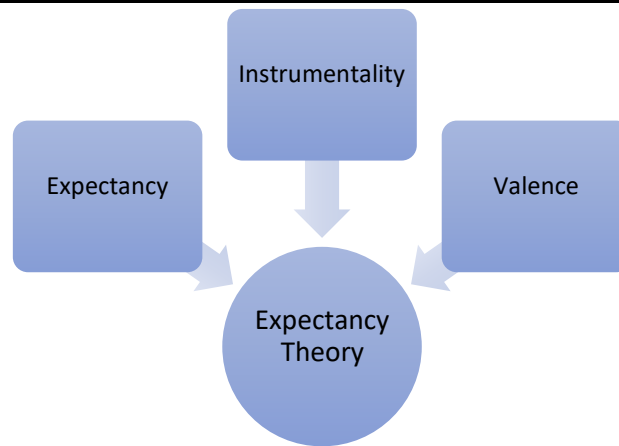
Figure 1: Vroom's Motivation Theory (source: Vroom, 1964)

2.5 Past Studies

2.5.1 Past Studies on Demotivating Factors to Learn Mathematics

Numerous studies have attempted to explain the demotivating factors to learn Mathematics (Bringula, de Leon, Rayala, Pascual, & Sendin, 2017, Susanti, 2015, Li et al., 2019, Kiemer et al., 2015). It is almost certain that more awareness on using basic mathematical skills and knowledge in analysing results and providing conclusions in present and future learning is a result of the demotivating factors in learning Mathematics (Bringula et al., 2017).

The study by Bringula et al. (2017) is done to investigate issues on the effects of different types of feedback of a mobile-assisted learning application and motivation towards mathematics learning on students' mathematics performance. This research focuses on 285 students and this study used an experimental pretest-posttest group design. The result of this study clarified the motivation towards learning mathematics is not significant with their own desire to learn. This study implies the student's motivation towards learning mathematics driven by the necessity of the subject in their course plan. Next, Kiemer et al. (2015) describes motivation in learning as determining the progress of education. Their studies aim to look at the effects of a classroom discourse intervention on teachers' practice and students' motivation to learn mathematics and science. This study focuses on the teacher and students' interaction by using intervention and control groups. This study justified the teachers' participation as not the only factors involved in cultivating the learning in Mathematics.

2.5.2 Past Studies on Motivating Factors to Learn Mathematics

Alternately, many studies have also been done to investigate factors that motivate learners to learn Mathematics. Research on students' motivation to learn Mathematics Yeh et al (2019) and Farhat (2020) found that students' performance and interest in Mathematics were influenced by few things namely self-efficacy beliefs and achievement goals.

In 2019, Yeh et al. conducted a study to improve students' mathematics achievement and interest among 215 elementary school students by developing a game based learning called Math Island. The result from the study showed that there was an increase in the students' achievement in terms of calculation and word problems. Overall, low achieving students and high achieving students from the study showed a high level of interest in learning Mathematics.

On the other hand, Syyeda (2020) conducted a study among adult learners in the United Kingdom who returned to the education field and decided to learn Mathematics offered for free by the government. She interviewed 21 respondents to find out the reasons and motivations for them to re-engage with Mathematics. Based on the interviews, themes were developed and she found that similar themes emerged from the interviews. The reasons for these people to study Mathematics again were found to be family, professional development, and personal development. Overall, the motivation for these people to study Mathematics again is for them to be able to help their children in doing homework and to get better job opportunities by equipping themselves with Mathematics.

In conclusion, there are many motivating factors for learning Mathematics where these factors differ based on age group. For children, it is found that they are interested to learn Mathematics when the learning is done in a game based situation while the motivating factors for adults to learn Mathematics as they see Mathematics as something that could improve their family life.

2.5.3 Conceptual Framework

The conceptual framework is rooted from Vroom's (1964) motivation theory and motivation for learning by Pintrich & De Groot (1990). Specifically, Vroom's (1964) three factors (a) Expectancy, (b) Instrumentality and (c) valence are scaffolded onto three characteristics by Pintrich & De Groot (1990) and presented in Figure 2 below. To be motivated to learn mathematics, learners need to have Expectancy. The learners need to feel that they can learn the topics in the course well. This motivation is needed for the learners to say "I can do this!". This drive can be enhanced through affective motivation and includes among others, the feelings of likeness towards achieving the goal. Next, instrumentality is the learners' belief that they can get something out of what they are doing. This can be reflected through expectancy motivation and depends on the learners' self-efficacy and control beliefs. Finally, valence is displayed through value motivation by the learners.
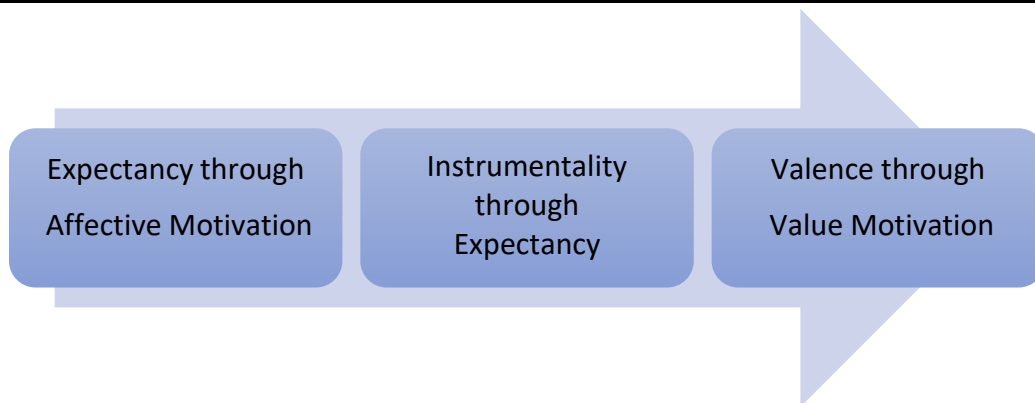
Figure 2: Conceptual Framework of the Study:
Motivation to Learn Mathematics (source: Vroom, 1964)

3. Methodology

3.1 Research Design

This quantitative study explores learners' motivation to learn mathematics using Vroom's theory. 234 participants from a responded to the instrument. The instrument (table 1) is a survey adapted from public university in Malaysia Pintrich & DeGroot (1990). Excluding the demographic profile, there are 24 items in total Section B is about Valence components with 12 items, section C is about expectancy components with 7 items; and section 4 is about affective components with 5 items.

Table 1: Distribution of Items in Instrument (Source: Pintrich & De Groot, 1990)

Sect.	Construct		Variable	No of Items	Total Items
A	Value Components	(a)	Intrinsic Goal Orientation	4	12
		(b)	Extrinsic Goal Orientation	3	
		(c)	Task Value Beliefs	5	
B	Expectancy Components	(a)	Students' Perception of Self- Efficacy	5	7
		(b)	Control Beliefs for Learning	2	
C	Affective Components				5
	Total No of Items				24

Table 2: Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
.880	24

SPSS analysis (Table 2) revealed a Cronbach's alpha of .880 for the 24 items, thus revealing a good internal reliability for the instrument used. Data is collected using google form via online. Data is analysed using SPSS version 26 and presented in terms of percentages for the demographic profile and mean score for section B-D to answer the research questions.

4. Findings

4.1 Introduction
This section presents the findings of the data analysed by answering the demographic profile.

4.2 Findings for Demographic Profile
4.2.1 Q1: Gender
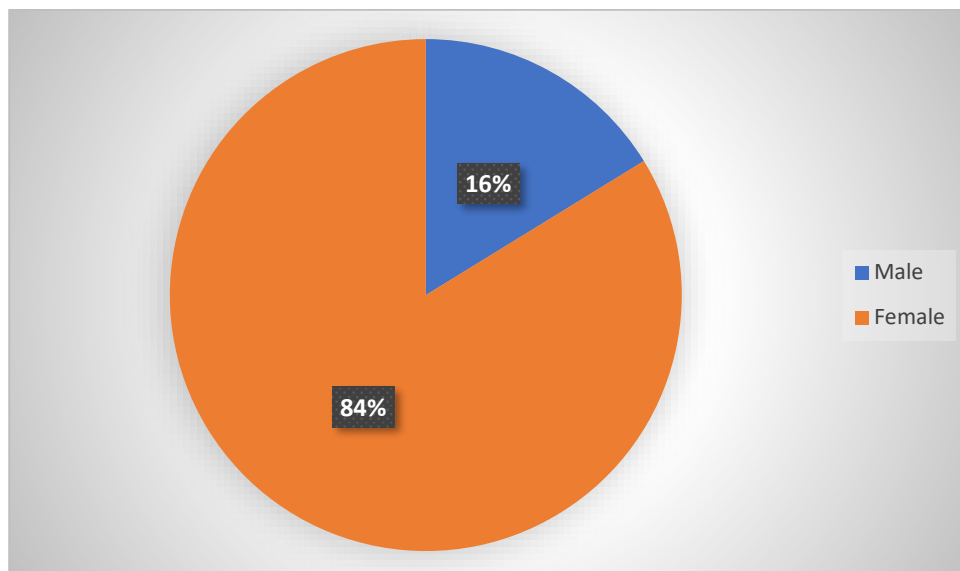
Figure 3: Percentage for Gender

Based on Figure 3, the analysis on gender shows 62% of respondents are male and 38% are female.

4.2.2 Q2: Discipline
Figure 4 shows the distribution by discipline. 37% shows that respondents were from the science and technology discipline. While 25% was from the business discipline followed by 23% from other disciplines and 3% from social sciences.
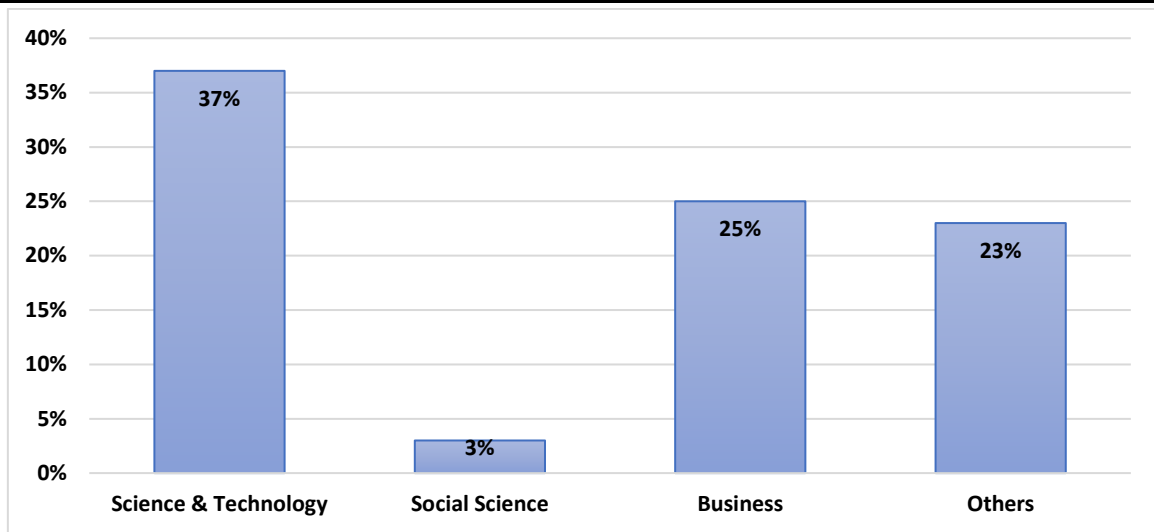
Figure 4: Percentage for Discipline

4.2.3 Q3: Faculty

Next, Figure 5 shows the percentage of faculty that participated in this research. The largest number of respondents were from the Faculty of Computers and Mathematical Science which was 28.6%, followed by 25.2% from the Faculty of Business Management. 15% of respondents were from the Faculty of Electrical Engineering and 10.7% from the Faculty of Civil Engineering. While 9% was from the Faculty of Mechanical Engineering. 6.4% was from the Faculty of Chemical Engineering, 4.7% from the Faculty of Plantation and Agrotechnology and 0.4% from the Faculty of Accountancy.
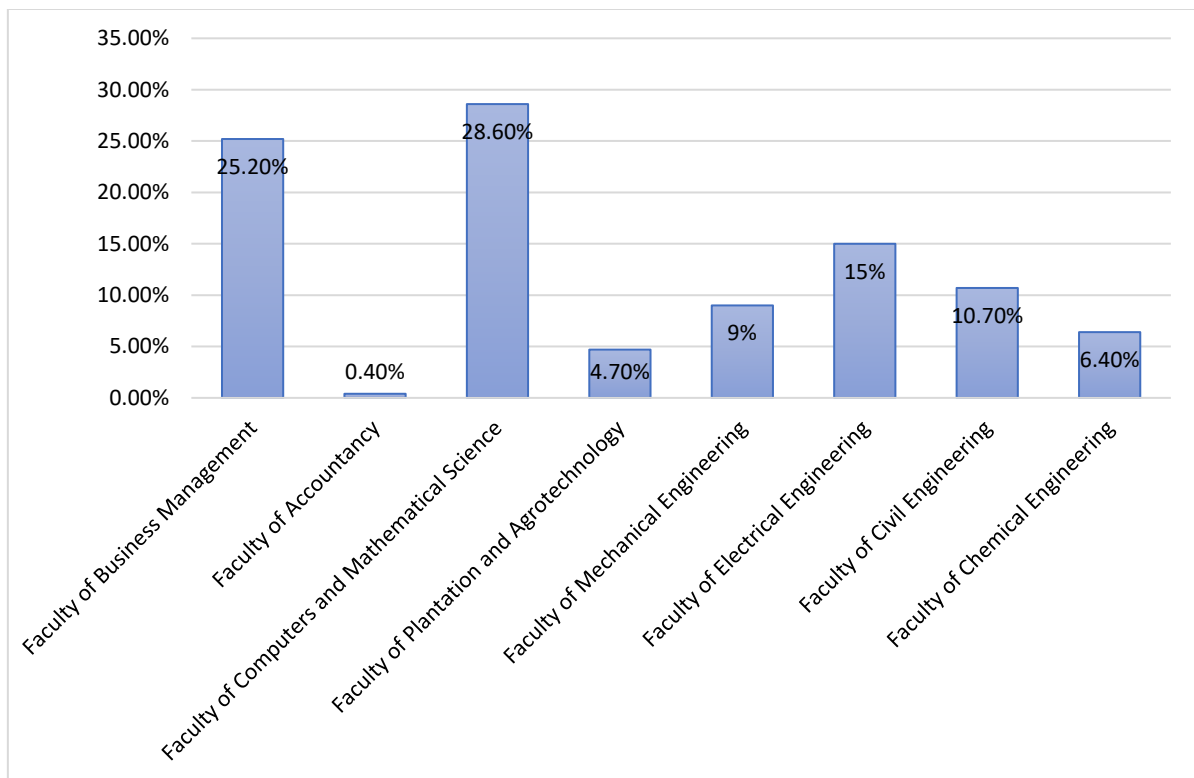
Figure 5: Percentage for Faculty

4.3 Findings for Expectancy

This section presents data to answer Research Question 1: How can affective motivation in learning Mathematics be portrayed in terms of expectancy motivation?

4.3.1 Affective Component
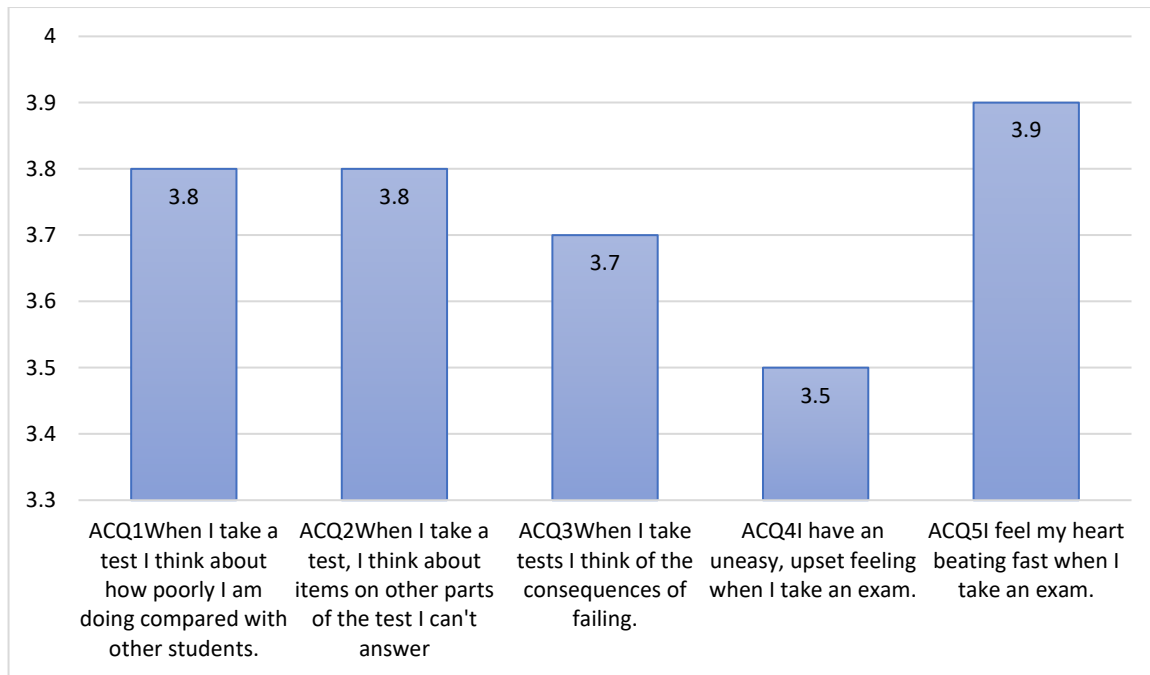
Figure 6: Mean for Affective Component

Figure 6 shows the mean for affective components. Most of the respondents agreed with the statement 'I feel my heart beating fast when I take an exam' as it recorded the highest mean value of 3.9. The statement 'When I take tests, I think of the consequences of failing' and 'I have an uneasy, upset feeling when I take an exam' recorded the second highest mean value with similar value at 3.8, while 'When I take tests I think of the consequences of failing' came in third with a mean value of 3.7. Lastly, 'I have an uneasy, upset feeling when I take an exam' recorded the lowest mean value at 3.5.

4.4 Findings for Instrumentality

This section answers Research Question 2: How does expectancy motivation in learning Mathematics be portrayed in terms of Instrumentality?

According to Pintrich & DeGroot (1990), instrumentality can be understood by looking at:
   a) students' perceptions of self-efficacy, and
   b) control beliefs of learners.

4.4.1 Expectancy Component- Students' Perception of Self-Efficacy

The Expectancy component shown in Figure 7a represents the students' perception on self-efficacy. The highest mean for this sub-component is "I believe I will receive excellent

grades in the classes" with 3.6 score value which is slightly higher than "Considering the difficulty of the courses, the teachers and my skills, I think I will do well in the classes". However, "I'm confident I can understand the most complex materials presented by the instructors in the courses" was the lowest mean with 3.3 score value for this sub-component.
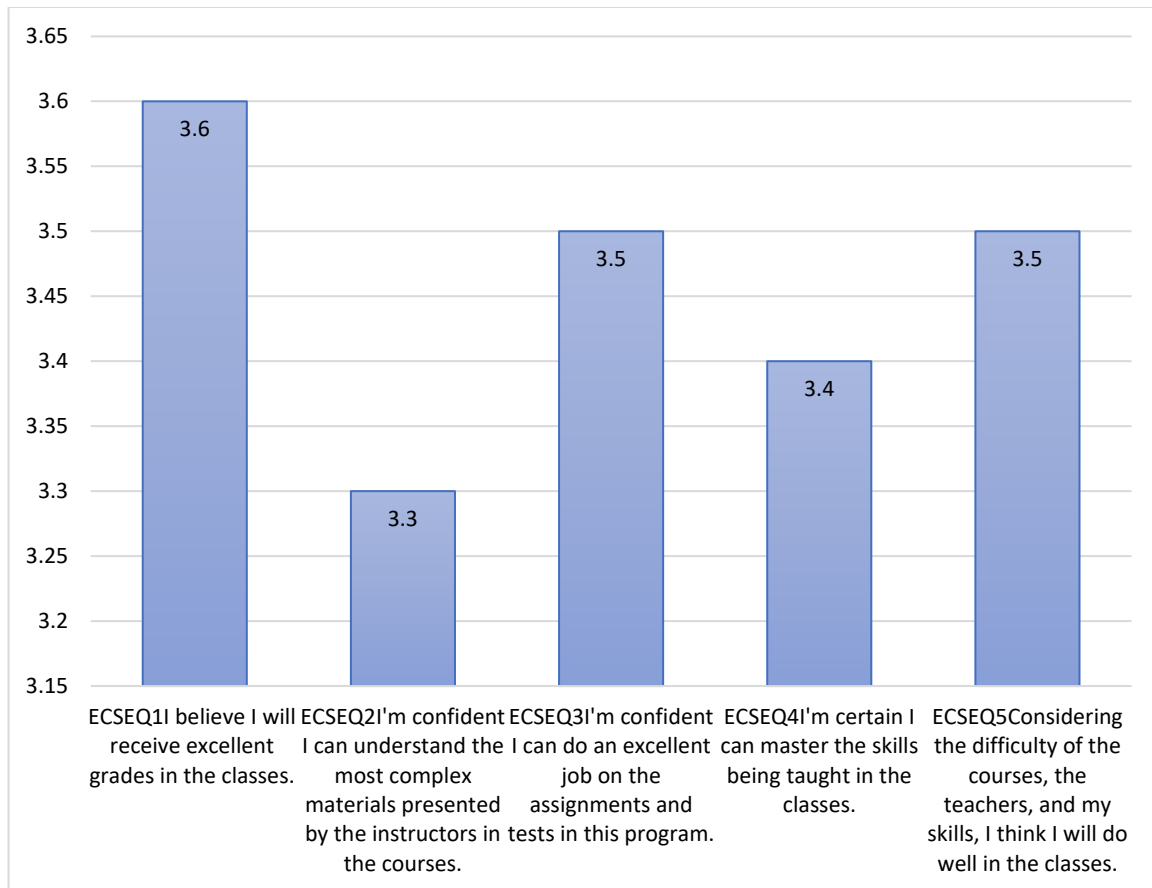

Figure 7a: Mean for Expectancy-Students' Perception

4.4.2 Control Beliefs for Learning

Meanwhile Figure 7b represents the sub-component control beliefs for learning. There are only two items in this sub component which the highest mean is "If I try hard enough, then I will understand the course materials" with mean score 4.1 and the other item "If I study in appropriate ways, then I will be able to learn the material in the courses of this program" with 4.0 score value.
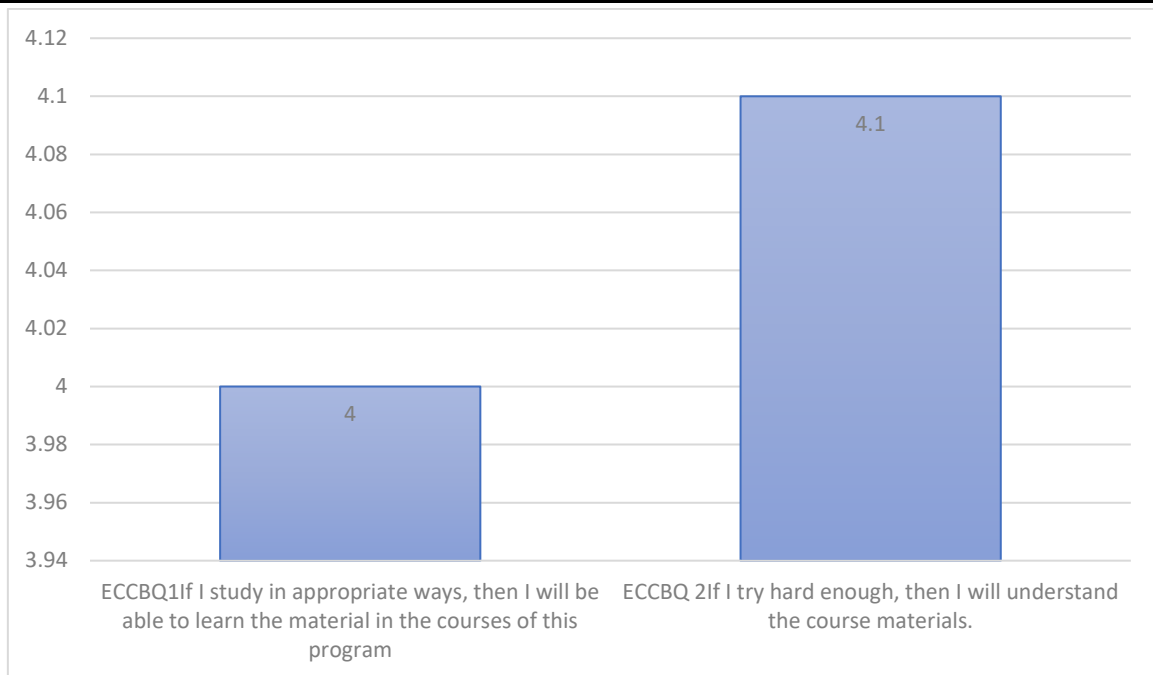
Figure 7b: Mean for Expectancy-Control Beliefs

4.5 Findings for Valence

This final section answers Research Question 3: How does value motivation in learning Mathematics be portrayed in terms of Valence? Valence is measured through learners' value components which includes:

a) Intrinsic goal orientation,
b) extrinsic goal orientation, and
c) task value beliefs.

4.5.1 Intrinsic Goal Orientation

Figure 8a summarizes the findings for intrinsic goal orientation. The statement 'The most satisfying thing for me in this program is trying to understand the content of the courses' has the highest mean score of 4.1 followed by 'In this program, I prefer class work that is challenging so I can learn new things' with a mean score of 3.6. The second lowest mean score is found in 'In the courses of a program like this, I prefer course materials that arouse my curiosity, even if they are difficult to learn' statement at 3.5 while the lowest mean score is found in 'When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade' at 3.4.
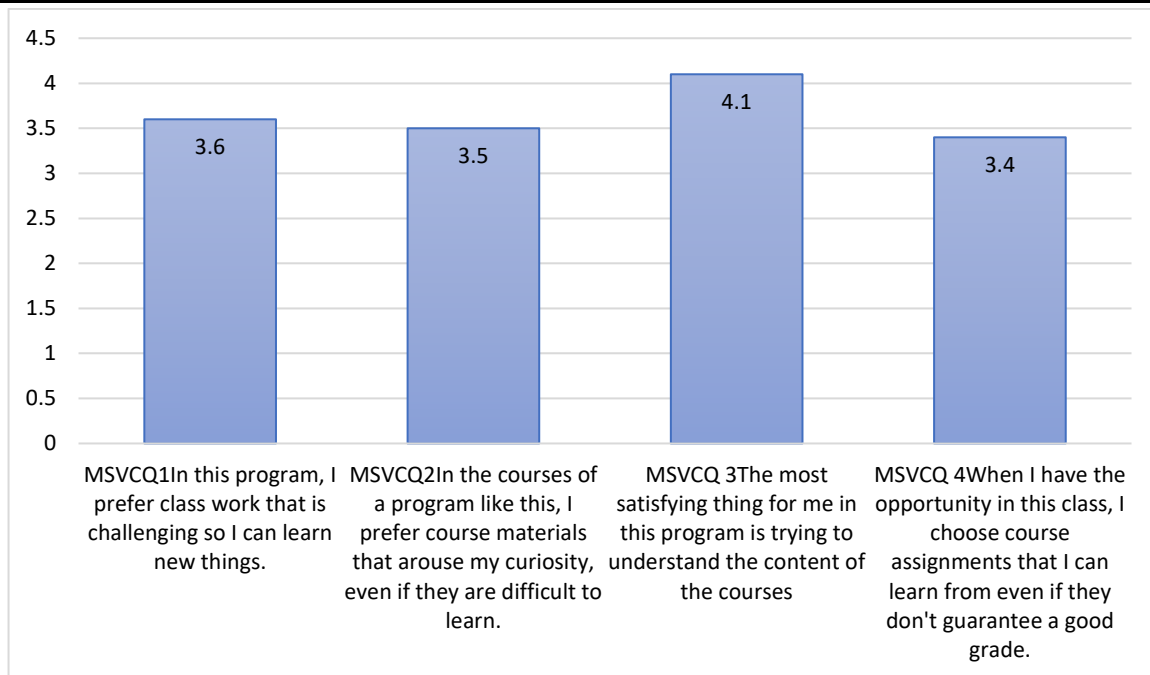
Figure 8a: Mean for Value- Intrinsic Goal Orientation

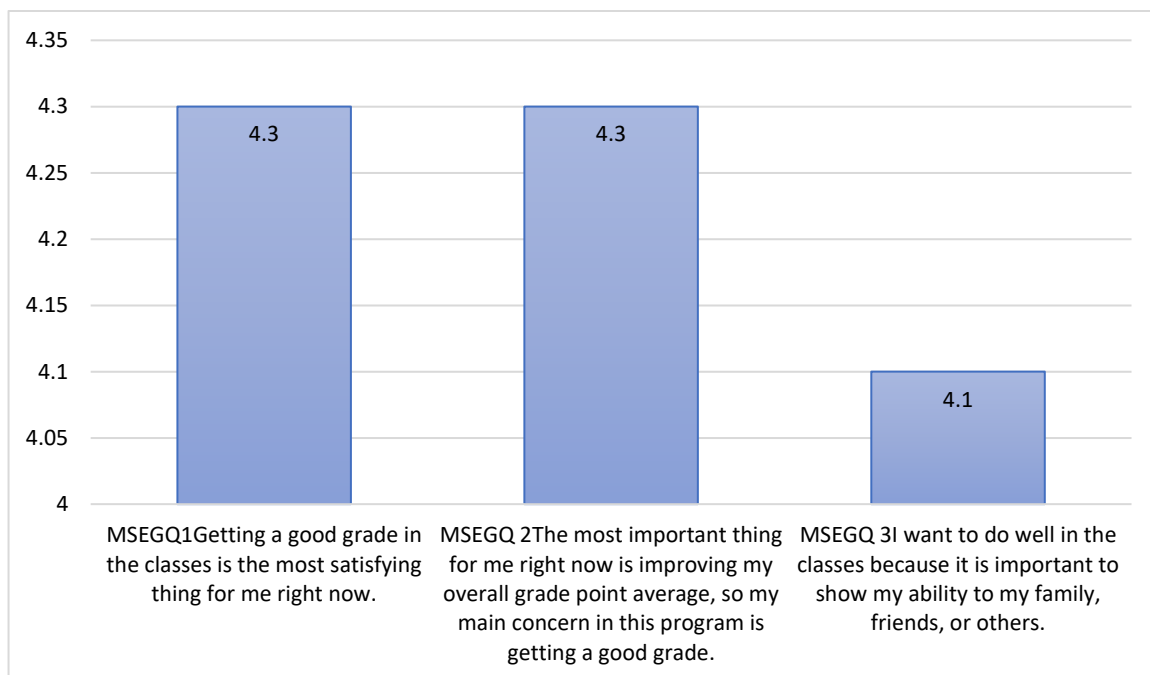## 4.5.2 Extrinsic Goal Orientation

Figure 8b: Mean for Extrinsic Goal Orientation

Figure 8b reviews the results for extrinsic goal orientation. The statement 'Getting a good grade in the classes is the most satisfying thing for me right now' and 'The most important thing for me right now is improving my overall grade point average, so my main concern in this program is getting a good grade' share the highest mean score of 4.3

followed by 'I want to do well in the classes because it is important to show my ability to my family, friends, or others' with mean score of 4.1.

4.5.3 Task Value Beliefs
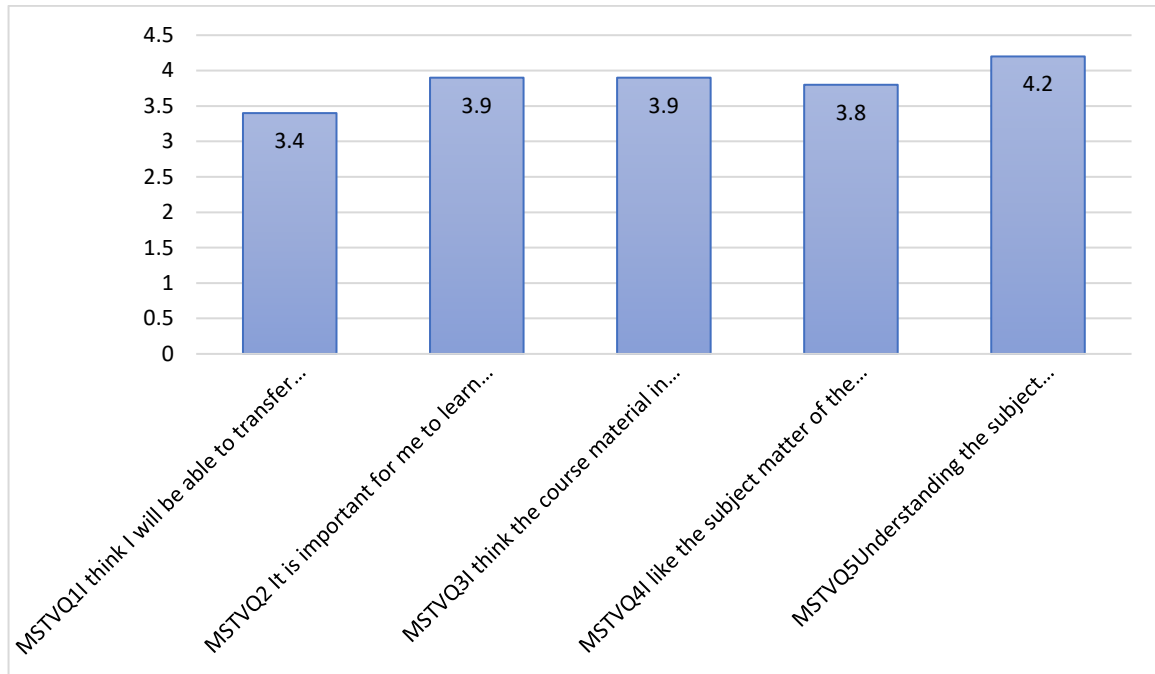
Figure 8c: Mean for Task Values Beliefs

On the other hand, Figure 8c outlines the findings for task values belief. It was found that the highest mean score is 'Understanding the subject matter of the courses is very important to me' (M=4.2), followed by 'It is important for me to learn the course materials in the courses' and 'I think the course material in the courses of this program is useful for me to learn' (M=3.9). The statement 'I like the subject matter of the courses' has a mean value of 3.8 while the lowest mean value is 'I think I will be able to transfer what I learn from one course to other courses in this program.' (M=3.4).

5. Conclusion

5.1 Summary of Findings and Discussion
In general, learners reported a high mean for "feel my heart beating fast". This shows that learners faced anxiety . This is also found in the study by Tobias & Weissbrod 1980 as cited in Rozgonjuk et al. 2020) who said that anxiety can be a demotivating factor in learning. Nevertheless, this anxiety can be turned into motivating factors if the learners are rewarded for high marks. Data from this study showed that respondents reported high mean scores for "I believe I will receive excellent grades in the classes" and "Considering the difficulty of the courses, the teachers and my skills, I think I will do well in the classes". The study by Vara, Rantakaulio and Eskol (2021) and also Sindoi (2020)

showed that learners' anxiety could be used as a fuel for them to perform well in Mathematics. The fear they had pushed them to work harder.
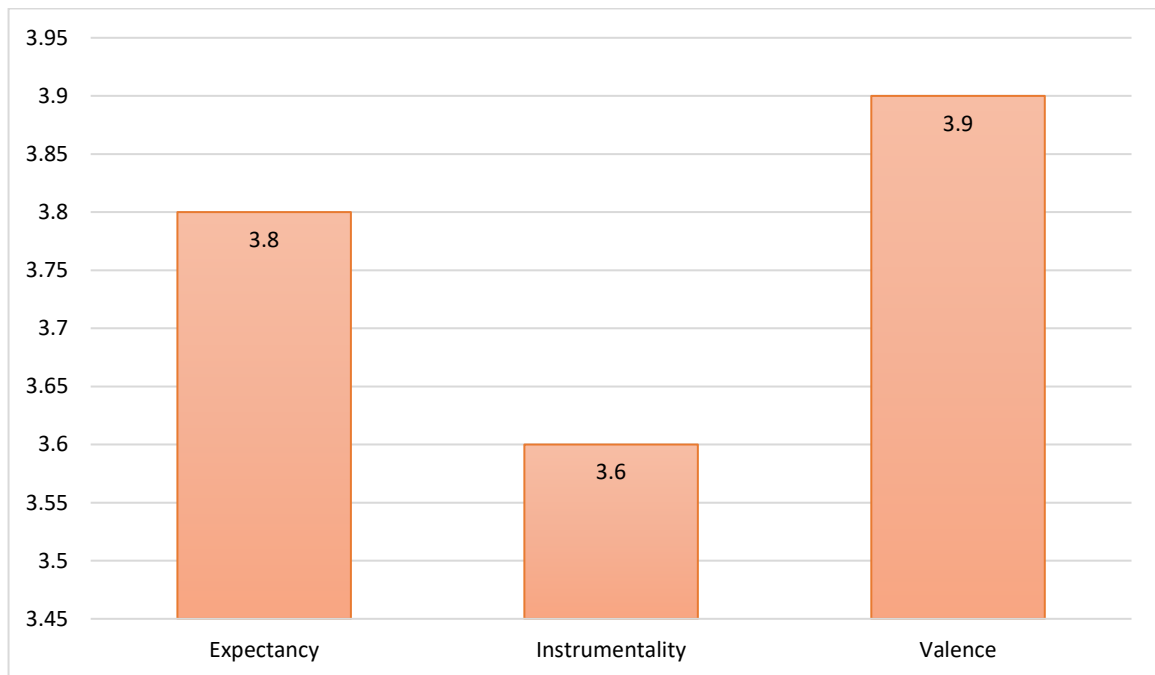

Figure 9: Total mean score for all Vroom's motivation

Figure 9 reveals the comparison of the total mean score for all three motivation factors categorized by Vroom. Data reveal that the respondents in this study reported the highest total mean for Valence. This means their motivation towards learning Mathematics is highly influenced by how much value they placed on the outcome of the learning (Vroom, 1964).

5.2 Pedagogical Implications and Suggestions for Future Research
From the learners' point of view several elements lead to learners` being motivated to learn Mathematics. Though various variables such as educators and learners' backgrounds do play a vital part, educators should bear the responsibilities of acknowledging the different types of learners around them and provide them with the academic and social support needed. Future research should focus on motivations given virtually during the Covid-19 era and cultivating a conducive study environment to enhance teaching and learning of Mathematics.

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Conflict of Interest Statement
The authors declare no conflicts of interests.

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