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ANXIETY AND INTRINSIC MOTIVATION IN LEARNING MATHEMATICS: A STUDY OF INDEPENDENT CHINESE SECONDARY SCHOOLS IN MALAYSIA

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ABSTRACT

Purpose – Mathematical literacy plays an important role in the current world. Despite important improvement in curriculum standards, secondary school students in Malaysia still perform poorly in international assessments. There are several possible reasons for this problematic state of affairs, but it is chiefly due to high mathematics anxiety, low intrinsic motivation in learning the subject, and questionable teaching modalities. To better understand the factors and potential solutions, the present study has examined the prevalence of mathematics anxiety and intrinsic motivation in learning mathematics in independent Chinese secondary schools in Malaysia. It is aimed at exploring the students' lived experiences and views about an ideal mathematics learning environment.

Methodology – A mixed-study approach was adopted. The quantitative study selected 379 Form 1 students from independent Chinese secondary schools to complete a set of questionnaires on mathematics anxiety and intrinsic motivation in mathematics. The qualitative aspect of the study included 20 students from the quantitative study to participate in one-on-one interviews. Descriptive statistics obtained from using IBM SPSS Statistic 22 were used to interpret the quantitative data, while a step-by-step process of analysis was used to interpret the qualitative data.

Findings – Findings from the present study revealed moderate levels of mathematics anxiety and intrinsic motivation in learning mathematics among students. Based on findings from the qualitative aspect of the study, the factors causing these issues and the proposed solutions for them were discussed.

Novelty – The present study sheds light on the challenges faced, factors identified, and solutions proposed for addressing mathematics anxiety and intrinsic motivation in learning mathematics. These recommendations may serve as a guide when designing teaching modalities that can better meet students' learning needs.

Significance – It is suggested that education practitioners shift their mindset from merely raising the difficulties in enacting the mathematics curriculum to developing teaching modalities that can ease students' mathematics anxiety and increase their intrinsic motivation in learning mathematics.

Keywords: Mathematics anxiety, intrinsic motivation in learning mathematics, traditional teaching method, gamification, collaborative learning.

INTRODUCTION

Mathematics is often seen as the backbone of various disciplines (Yong et al., 2016; Zuber & Sulaiman, 2019). As we enter the era of the Fourth Industrial Revolution (4IR), the increasing demand for science, technology, engineering, and mathematics (STEM) workers has further emphasized the importance of mathematics (Gabriel et al., 2020). However, despite learning mathematics since pre-school, the achievement of Malaysian 15-year-old students in mathematics, defined as the competency shown by students in mathematics (Pandey, 2017), was still at a low level as indicated in the assessments by the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS). This was despite the fact that the country has been increasing the difficulty of the subject in the mathematics syllabus (OECD, 2023; Parkaran, 2022; von Davier, 2024).

Factors Affecting Mathematics Achievement

Mathematics Intrinsic Motivation

Defined as one's desire or drive to engage in learning mathematics for the sake of learning, mathematics intrinsic motivation is frequently linked with students' mathematics achievement (Atit et al., 2020). Unlike mathematics extrinsic motivation which is regulated by outside external rewards, students with high mathematics intrinsic motivation are found to find enjoyment in the mathematics activity itself, without the need to offer incentives (Karlen, 2019; Ryan & Deci, 2020). These students are more persistent in their efforts when facing complicated mathematics tasks (Güvendir, 2016; Wu, 2003).

In terms of its relationship with mathematics achievement, mathematics intrinsic motivation is widely accepted as a tremendous boost for mathematics achievement (Atit et al., 2020; Baker, 2023). Intrinsically motivated students have been found to enjoy and willing to solve mathematical tasks, and are more engaged or put in greater effort in math-related activities (Gottfried, 2019; Karlen et al., 2019, Liu & Hou, 2018). These findings have been further supported in the study by Rodrigues et al. (2021). They revealed that individuals with high intrinsic motivation tended to be more persistent when solving related tasks, which in turn led to better performance in the subject.

Mathematics Anxiety

Mathematics anxiety, defined as feelings of tension, apprehension, or fear in math-related activities, is a factor frequently proposed as one of the biggest obstacles in mathematics achievement (Ashcraft, 2002; Ashcraft & Krause, 2007; Barroso, 2024; Jansen et al., 2013; Namkung et al., 2019; Schukajlow et al., 2023). Students with mathematics anxiety are found to have the tendency to avoid mathematics task such as homework and have lower out-of-class engagement (Ashcraft & Moore, 2009; Choe et al., 2019; Hirvonen et al., 2012; Song et al., 2023). In terms of its prevalence, mathematics anxiety is viewed as being most prominent when students are in their junior high school, which may be explained by the increased difficulty of the mathematics curriculum in high school when compared to that in elementary school (Ashcraft & Ridley, 2015; Ramirez et al., 2018).

While there has been a debate on the temporal antecedence in the relationship between mathematics anxiety and mathematics achievement (Devine et al., 2012), recent research proposes a vicious cycle between mathematics anxiety and mathematics achievement, such that poor achievement may elicit mathematics anxiety, which may then cause performance to further decline (Namkung et al., 2019; Pellizzoni et al., 2022). For example, mathematics anxiety has been found to lower students' working memory capacity required in solving mathematics and therefore, lower their mathematics achievement (Schukajlow et al., 2023). Moreover, low mathematics achievement was found to increase students' anxiety towards mathematics due to their unpleasant experience of the previous poor achievement (Ma & Xu, 2004; Zhang et al., 2019).

From the foregoing discussions it is clear that mathematics anxiety and intrinsic motivation do predict students' mathematics achievement. Researchers have therefore, started to examine the underlying causes or factors associated with low mathematics intrinsic motivation and high mathematics anxiety. Secondary school students in Malaysia have also been found to suffer from low mathematics intrinsic motivation and high mathematics anxiety (Mohamed & Tarmizi, 2010; Omar, 2022; Puteh & Khalin, 2016; Sabri, 2025; Thien & Ong, 2015; Zakaria et al., 2012). Therefore, in light of the growing concern about mathematics anxiety and intrinsic motivation, the present study is an attempt to examine how these two underlying factors have impacted secondary school students' mathematics achievement in the country.

Teaching Methodologies

Traditional Teaching Method

In the study conducted by Mohd Radzuan et al. (2023), it was found that Malaysian mainstream mathematics teaching modality still revolved around the traditional teaching method, a teacher-centered teaching method where students acted as passive recipients of knowledge (Hossain et al., 2012). This is further supported by other research studies which showed that secondary school teachers in Malaysia still preferred traditional teaching methods or relied heavily on the use of textbooks (Azar & Tan, 2020; Chin et al., 2022). Although such one-way communication enables knowledge memorisation through drill practices, it is no longer sufficient to help students succeed in this challenging 21st century where Higher Order Thinking (HOT) skills, such as communication, problem-solving, and critical thinking skills are emphasized (Cevikbaş & Kaiser, 2020; Dairo et al., 2024).

Furthermore, the traditional teaching method has been found to lead to mathematics anxiety and low intrinsic motivation towards mathematics (Azuan & Rosly, 2025; Irmayanti et al., 2025; Stiglbauer et al., 2013; Yüksel-Şahin, 2008). The utilization of authoritarian teaching style in traditional teaching methods may create a fearsome classroom environment where students may hesitate to ask or answer questions (Yüksel-Şahin, 2008). Besides, failure is often not tolerated and viewed as a negative event in traditional classrooms and therefore, may lead to higher mathematics anxiety whenever students anticipate failure (Yanuarto, 2016). In addition, mathematics is found to be disliked and seen as a difficult subject by most students due to the difficulty in understanding and remembering equations, and such negative attitudes may lead to low mathematics intrinsic motivation among students (Gafoor & Kurukkan, 2015).

In short, although the traditional teaching method has served students well for decades, it is seen as having failed to fulfill 21st century students' learning needs and may have increased students' mathematics anxiety while reducing their mathematics intrinsic motivation (Azuan & Rosly, 2025; Cevikbaş & Kaiser, 2020; Irmayanti et al., 2025). As a result of the combination of these two major factors, students have shown low mathematics achievement. Therefore, it is no surprise that in past decades, researchers have been looking for ways to reduce students' mathematics anxiety and enhance intrinsic motivation, which may in turn increase their mathematics achievement.

Gamification

In the past decade, there has been an increased use of gamification, defined as the use of game elements in a non-game system (Deterding et al., 2011), as a means to increase intrinsic motivation and achievement in students' learning (Hung et al., 2014; Li et al., 2024). In terms of mathematics learning, it has been shown that by incorporating game elements in mathematics teaching, students will experience higher intrinsic motivation towards mathematics and therefore, have higher mathematics achievement (Chan et al., 2018; Dignan, 2014; Hamari et al., 2014; Sotto, 2023). Interestingly, while the inclusion of game elements such as badges and reward systems are normally seen as external rewards to motivate students, this is not necessarily the case in gamification. In gamification, such game elements are used to create an extrinsically motivated condition that assigns value to otherwise menial tasks, and therefore encourages intrinsic motivation (Hanus & Fox, 2015; Xu et al., 2021).

In addition, gamification may also be an effective teaching modality in reducing students' mathematics anxiety (Maryana et al., 2024; Subramaniam & Saleh, 2024). Such a positive effect may be due to the nature of gamification, as it emphasizes a positive relationship with failure in such a way that failure is accepted, and multiple attempts are encouraged (Buckley & Doyle, 2014). In addition, gamification is seen as having the potential to create perceptions of fun and enjoyment which may help in creating relaxation in highly anxious students and therefore, facilitate their learning (Subramaniam & Saleh, 2024; Zainuddin et al., 2020).

However, when replicating the effect of gamification in other contexts or when a bigger sample size was used, some researchers indicated no improvement in mathematics motivation when their participants were exposed to gamification (Diefenbach & Müssig, 2018; Hamari et al., 2014; Ninaus et al., 2020). Such inconsistent results have prompted researchers to look for the confounding variables in gamification (Buckley & Doyle, 2014; Jiang, 2016; Osatuyi et al., 2018).

It is proposed that relationships with peers play a significant role in the secondary school learning environment. This is because it is strongly related to the need for relatedness (Froiland & Davison, 2016; Schimmelpfennig, 2025). However, the element of competition in gamification may affect peer relationships or increase mathematics anxiety (Dindar et al., 2021). In addition, students may express negative emotions such as anxiety and jealousy when failing to achieve top positions in gamification (Bai et al., 2020; Çakıroğlu et al., 2017). It is possible that through gamification, students may develop higher mathematics anxiety, while improving the mathematics intrinsic motivation of those who have already performed well.

Collaborative Learning

Collaborative learning, defined as a situation where groups of students work together to solve, complete, or create something (Serrano-Cámara et al., 2014), is another teaching modality frequently discussed in the educational field to improve students' learning by boosting their mathematics intrinsic motivation (Habtamu et al., 2022; MacGregor, 1990; Sujatha & Vinayakan, 2022; Wang, 2007). In collaborative learning, students work with one another and are challenged to listen and articulate opinions to develop a unique conceptual framework (Davison & Major, 2014; Laal & Laal, 2012). Such active exchanges of ideas may help students to understand mathematics concepts in a collaborative, meaningful, and enjoyable way and increase their motivation (Gokhale, 1995; Sujatha & Vinayakan, 2022).

In terms of mathematics anxiety, collaborative learning has been shown to be able to reduce students' mathematics anxiety (Townsend et al., 1998; Kadonsi, 2025). Ansari and Wahyu (2017) suggested that the potential cause of mathematics anxiety – teacher authority, is reduced in collaborative learning as the teacher has become a facilitator who students can discuss with, thereby reducing mathematics anxiety.

While the effect of collaborative learning on mathematics intrinsic motivation and mathematics anxiety sounds promising, the unbalanced participation or unequal level of participation has been proposed as a confounding variable in influencing its outcome (Cohen, 1994; Janssen et al., 2007; Lowyck & Pöysä, 2001; Sujatha & Vinayakan, 2022). It has been suggested that students are not motivated to participate in the discussion initially, and therefore their basic psychological needs may not have been fulfilled during the lesson.

To summarize, traditional teaching methods are no longer sufficient to meet the needs of today's secondary school students in learning mathematics. Student-centered teaching modalities are needed to benefit students in their mathematics achievement by increasing their mathematics intrinsic motivation while reducing mathematics anxiety. Suggestions to use gamification and collaborative learning, however, also suffer from some flaws in their design which may hinder their full potential in benefiting students.

Present Study

Based on past studies, two gaps were found when researchers discussed how teaching modalities were related to mathematics anxiety or intrinsic motivation.

Firstly, while Malaysia has introduced the new Kurikulum Standard Sekolah Menengah (KSSM) to augment the difficulty of the subject in the mathematics syllabus (Khalid et al., 2020), studies conducted to measure students' levels of mathematics anxiety and mathematics intrinsic motivation were mostly conducted a decade ago (Mohamed & Tarmizi, 2010; Puteh & Khalin, 2011; Thien & Ong, 2015; Zakaria et al., 2012). The question, therefore, arises as to the reliability and validity of the findings from these past studies. In addition, these previous studies rarely focused on Form 1 students, who have been seen as particularly vulnerable to mathematics anxiety due to the various transition they experience.

Secondly, while the traditional teaching method has been frequently examined together with students' mathematics anxiety and mathematics motivation, most of the research focused only on its effect, and solutions were rarely discussed or examined. Furthermore, when exploring the effect of the traditional teaching method, researchers tended to focus on quantitative data by collecting students' responses on questionnaires. Students were rarely given a chance to share their experiences in daily mathematics lessons or their thoughts on improving the current learning environment, which might be especially useful when designing suitable teaching modalities for them.

Therefore, the present study aims to (1) examine the level of mathematics anxiety and mathematics intrinsic motivation among Malaysian secondary school students, and (2) to explore the Malaysian secondary school students' lived experiences in mathematics classrooms and their perspective of the ideal mathematics learning environment.

The present study will provide a holistic view of how significant problems with mathematics anxiety and mathematics intrinsic motivation are in Malaysian secondary schools. Exploring the experience of current teaching methods and the ideal mathematics learning environments from students' perspectives may provide a better understanding of the effect of teaching modalities on students and help develop effective teaching modalities. While the present study did not have the resources to run a full-scale study, the small group results found in the present study may provide great insights and may be used by future research in this area.

METHODOLOGY

Design

The present study adopted a mixed-method approach, which incorporated the following two research methodologies: (1) a non-experimental descriptive study to measure the mathematics anxiety and mathematics intrinsic motivation levels of Form 1 students in Malaysia through questionnaires, and (2) a face-to-face semi-structured interview of students, giving them the opportunity to share their lived experiences in the mathematics classrooms and their perspective of the ideal mathematics learning environment. The qualitative data were obtained shortly after the collection of the quantitative data and both types of data were analyzed independently. By incorporating the findings of both quantitative and qualitative studies, a more holistic understanding of students' experiences in their mathematics learning can be obtained.

Participants

Convenience and purposive sampling methods were employed for both the quantitative and qualitative aspects of the present study. As the Malaysian Chinese Independent secondary schools in the states of Selangor and Johor met the vast numbers of participants needed, and were conveniently located research sites for the researchers, students from these schools were recruited for the study. Only students who were in Form 1 (Ages 12-14 years old) and were taking mathematics subjects were recruited. Based on the rule of thumb for non-experimental studies (Bujang et al., 2017), a total of 379 participants (123 males, 123 females) aged from 13 to 14 years old ($M = 13.5$, $SD = 1.3$) were recruited from three Malaysian Chinese independent secondary schools. The majority of the participants were Chinese (97.6%).

Based on the results of the quantitative study, purposive sampling was adopted to recruit twenty respondents (6 males, 14 females) to participate in the interview conducted at the school (Marshall et al., 2013). These were students who had either low mathematics anxiety, high mathematics anxiety, low mathematics intrinsic motivation, or high mathematics intrinsic motivation. The final samples included five participants who met each of the above criterion on mathematics anxiety and mathematics intrinsic motivation.

Materials

The present study used Google Forms as the platform to collect the quantitative data. The Google Forms contained a parent consent form, demographic form, Math Anxiety Scale (MAS), Intrinsically Motivated Subscale of Mathematics Motivation Questionnaire (MIM), and a thank you message.

As the present study approached the Chinese independent schools as the primary source of participants, English and Mandarin versions of questionnaires were prepared for participants to select, based on their language preference. All questionnaires and interview questions used were originally developed in English. To ensure the intended meaning was retained when the Mandarin version of the questionnaire was used, back translations were validated by five bilingual individuals with adequate knowledge in questionnaire development. All individuals were satisfied with the suitability and comprehensibility of the items in the Mandarin version of the questionnaire.

Demographic Form

A demographic questionnaire was prepared for participants to fill in particulars about their age, gender, and a non-mandatory request to provide their email or phone number if they would like to participate in the second part of the study.

Math Anxiety Scale

The Math Anxiety Scale (MAS) was adopted from Mahmood and Khatoon (2011). It was employed to measure participants' feelings of tension, apprehension, or fear in math-related activities. The MAS was designed to measure mathematics anxiety of secondary school students and had excellent inter-item reliability (Cronbach's $\alpha = .87$). In addition, the description of items was aligned with the definition of mathematics anxiety assessed in the present study. The MAS consists of 14 items scored on a 5-point Likert

scale ranging from 1 "Strongly Disagree" to 5 "Strongly Agree". Scores were calculated based on the total score on the scale: where scores between 14-32 indicated low mathematics anxiety; scores between 33-51 indicated a moderate level of mathematics anxiety; and scores between 52-70 indicated a high level of mathematics anxiety (Mutegi et al., 2021). Examples of items included "Math makes me feel comfortable and easy" and "Math is the most dreaded subject for me". A summary of items and the inter-reliability of MAS is as shown in Table 1.

Table 1

Summary of Variables and Items

Variable	Item	Inter-Item Reliability
Mathematics Anxiety	14	.87
Mathematics Intrinsic Motivation	3	.85

Intrinsically Motivated Math Learning Sub-scale of Math Motivation Questionnaire

As the present study has only focused on the intrinsic aspect of mathematics motivation, the Intrinsically Motivated Math Learning sub-scale of Math Motivation Questionnaire was adopted to measure the desire or drive of participants to engage in learning mathematics for the sake of learning (Atit et al., 2020). The scale was originally a five-item scale but was revised into a 3-item scale in the study conducted by Fiorella et al. (2021). This revision carried out in order adjust to the specific profiles of secondary school students. The scale had excellent inter-item reliability (Cronbach's alpha = .85) and was corroborated in research conducted in Malaysia (Abdullah et al., 2024). In addition, the description of items was aligned with the definition of mathematics intrinsic motivation assessed in the present study. Scores were calculated based on the total score on the scale which uses a 5-point Likert Scale ranging from 1 "Never" to 5 "Always"; where scores lower than 1 SD below the mean were counted as low mathematics intrinsic motivation while scores higher than 1 SD above the mean were counted as high mathematics intrinsic motivation. Examples of items included "I enjoy learning mathematics" and "I like mathematics that challenges me". A summary of items and inter-reliability of the scale is as shown in Table 1.

Interview Questions

The qualitative data were collected by having participants answer semi-structured interview questions related to their current and ideal perspective of the mathematics learning environment. The interview questions were carefully constructed based on the research questions (See Appendix A for the interview questions used in the qualitative aspect of this study), and were validated by expert researchers in the field. Examples included "How would you describe your current mathematics learning environment" and "How would you describe an ideal mathematics learning environment".

Procedures

The present study was conducted after obtaining ethics approval from the researchers' university and permission from the school headmasters of the selected schools. Permission from the Ministry of Education, Malaysia was not required as only private schools were selected in the present study.

Upon receiving all the approvals needed, counselling teachers were instructed to explain the nature of the quantitative study to all students. Students were informed that participation was voluntary, and their decisions or answers would not affect their results in school. The right to withdraw from the study at any point in time was also communicated. Students were given time to complete the study's Google Form after they had understood the nature and details of the present study. The process of filling out the Google Form took less than 10 minutes to complete.

The collection of qualitative data proceeded after the quantitative phase of the study. Twenty participants who indicated willingness to participate were identified and invited to participate in the interview. Participants were informed about the nature of the study. The issue of the privacy and confidentiality of participants involved in the study was also addressed and assured. Participants were asked to have their parent consent forms and child assent forms signed (See Appendix B & C for examples of the parent consent form and child assent form). All participants agreed to be audio-recorded throughout the interview. The qualitative interviews were conducted using Mandarin as the main language, in the counselling room of the school during lesson time. Participants were encouraged to share their views as much as possible during the interview. Each interview took approximately 20 minutes to complete.

Data Analysis

IBM SPSS Statistic 22 was used to analyze the quantitative data collected in the present study. Upon completion of the quantitative study, participants' total scores on the Math Anxiety Scale (MAS) and Intrinsically Motivated Math Learning subscale of Math Motivation Questionnaire (MMQ) were calculated separately.

To answer the first aim, the descriptive statistics of mathematics anxiety and mathematics intrinsic motivation were also obtained to find out the mean and range of participants' scores.

The step-by-step process of analysis proposed by Merriam and Tisdell (2016) was used to analyze the qualitative data. The audio recordings obtained during the interviews were first transcribed and translated into English with minor grammatical corrections which did not alter the meaning. The data was then open-coded and categorized into different themes. These processes were simultaneously conducted by the researchers and two individuals with adequate knowledge and experience in qualitative study. The results were compared and contrasted to identify the themes. The final theme was validated by another individual with professional knowledge in the field.

Finally, relationships were drawn between the findings from the quantitative and qualitative data to provide a more holistic view of the concerns investigated in the present study.

RESULTS

Quantitative Results

The first objective of the present study was to examine the prevalence of mathematics anxiety and mathematics intrinsic motivation among independent Chinese secondary school students. As such, descriptive statistical analysis was used to analyze the quantitative data collected.

Demographic Profile of Respondents

The present study involved a total of 379 students from three independent Chinese Secondary Schools located in Selangor and Johor State. Among the participants, 54.4% were females, 43.3% were males and 2.4% identified themselves as other genders. Due to the extended data collection period of over 1 year, participants' ages were ranged from 12 to 14 years old with 77.3% being 14 years old.

Prevalence of Mathematics Anxiety

As shown in Table 2, participants in the present study had an overall mean score of 39.91 (SD = 13.40) on the Math Anxiety Scale (Cronbach's alpha = .933), indicating moderate mathematics anxiety across participants. Among them, 116 participants (30%) were reported to have low mathematics anxiety, 181 participants (50%) having moderate level of mathematics anxiety, while 82 participants (20%) having a high level of mathematics anxiety.

Table 2

Descriptive Statistics of Mathematics Anxiety

No.	Item	Mean	SD
1.	Math makes me feel comfortable and easy. *	2.93	1.15
2.	Math is most dreaded subject for me.	2.69	1.31
3.	I feel worried before entering the math class.	2.52	1.23
4.	I find math interesting. *	2.72	1.26
5.	Math is one of my favourite subjects. *	3.08	1.43
6.	I am always afraid of math exams.	3.02	1.41
7.	Solving math problems is always pleasant for me. *	2.58	1.34
8.	I feel nervous when I am about to do math homework.	2.37	1.23
9.	I feel happy and excited in a math class as compared to any other class. *	3.24	1.25
10.	I would prefer math as one of my subjects in higher studies. *	3.07	1.32
11.	Math is a headache for me.	2.91	1.37
12.	I am afraid to ask questions in math class.	2.82	1.34
13.	Math doesn't scare me at all. *	3.06	1.33
14.	My mind goes blank when teacher asks math questions.	2.87	1.31
		39.91	13.40

Notes. * denotes Reverse-scored items

Based on the results, the mean for individual items ranged from 2.37 to 3.24, suggesting variability of participants' mathematics anxiety. The highest mean was item 9 "I feel happy and excited in a math class as compared to any other class" (M = 3.24, SD = 1.25), which seems to suggest that participants generally did not feel happy or excited towards their mathematics classes. The lowest mean was item 8 "I feel nervous when I am about to do math homework" (M = 2.37, SD = 1.23), indicating that participants had relatively lower anxiety in completing their mathematics homework.

Prevalence of Mathematics Intrinsic Motivation

As shown in Table 3, participants in the present study had an overall mean score of 9.29 (SD = 3.50) and a Cronbach alpha of 0.896, indicating a moderate level of mathematics intrinsic motivation. Among them, 91 participants (24%) were reported to have low mathematics intrinsic motivation, 213 participants (56%) as having a moderate level of mathematics intrinsic motivation, while 75 participants (25%) having a high level of mathematics intrinsic motivation.

Table 3

Descriptive Statistics of Mathematics Intrinsic Motivation

No.	Item	Mean	SD
1.	I enjoy learning math.	3.15	1.21
2.	I find learning math interesting.	3.22	1.26
3.	I like math that challenges me.	2.93	1.37
		9.29	3.50

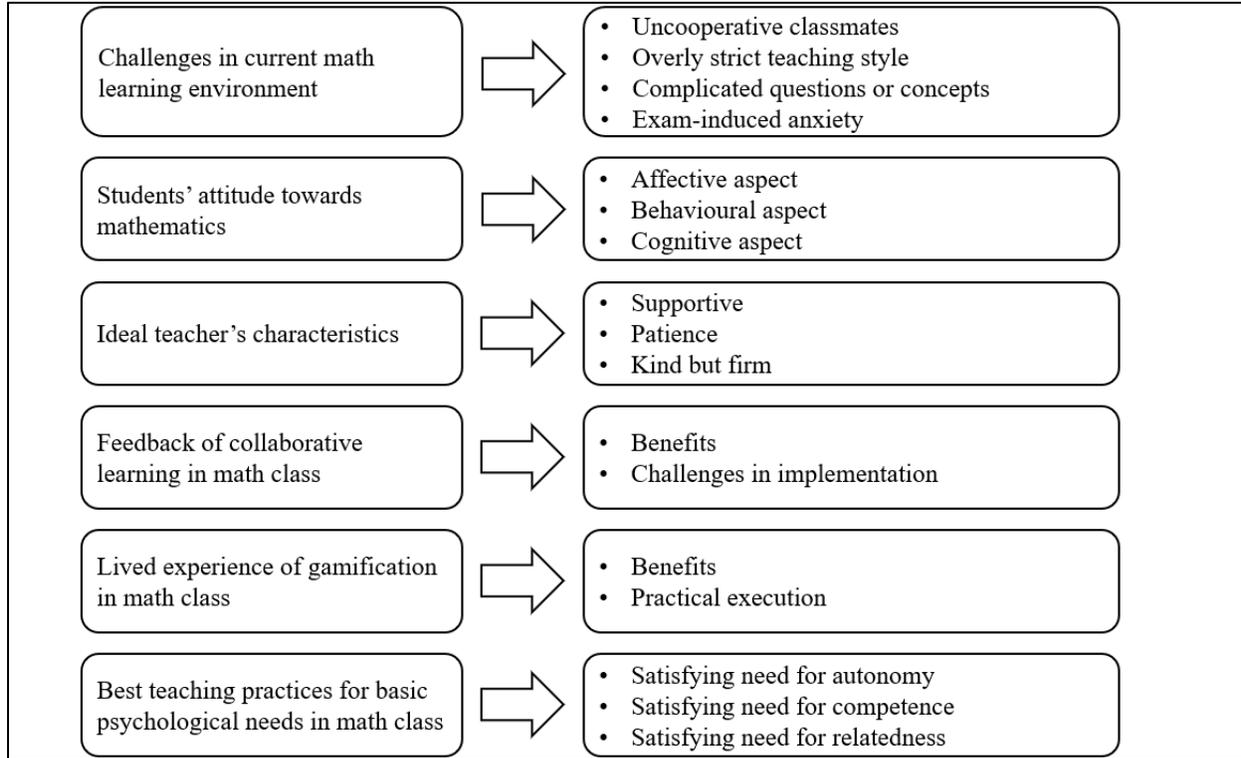
The mean for individual items ranged from 2.93 to 3.22, suggesting participants' moderate mathematics intrinsic motivation across different mathematics context. The highest mean was item 2 "I find learning math interesting" (M = 3.22, SD = 1.26), which seems to suggest that most participants expressed moderate interest towards learning mathematics. The lowest mean was item 3 "I like math that challenges me" (M = 2.93, SD = 1.37), indicating participants were less intrinsically motivated by challenging mathematics tasks.

Qualitative Findings

The second objective of the present study was to explore Malaysian secondary school students' lived experiences in the mathematics class and their perspective of the ideal mathematics learning environment. Interviews were conducted to collect the qualitative data. Analysis of the data revealed six main themes and seventeen sub-themes, as is illustrated in the Figure 1.

Figure 1

Independent Chinese Secondary School Students' Lived Experience in the Mathematics Class and Their Perspective of the Ideal Mathematics Learning Environment



Theme 1: Challenges in the Current Math Learning Environment

All participants shared the kind of challenges they faced during daily mathematics lessons, including uncooperative classmates, overly strict teaching styles, complicated questions or concepts, and exam-induced anxiety.

Although there is the intention to pay attention and learn well during mathematics class, some participants expressed their helplessness when lessons were interrupted by classmates who were chatting or sleeping, and lesson time was spent resolving such disciplinary issues, and the students losing precious learning time. The following were the remarks made by some of the participants:

It's just that there will be a little noise during the lesson, and sometimes many students are talking, so I can't hear the teacher clearly. (P10)

Because the teacher kept talking, some students might feel bored and fall asleep. (P9)

First of all, I think the teacher's teaching method is mainly aimed at helping us absorb more knowledge, but most of his time is spent scolding students. (P1)

While some teachers adopted a stricter teaching style to reduce disciplinary issues in class, issues arose where students did not dare to ask teachers for clarification when they faced difficulties in their mathematics learning. Such overly strict teaching styles were reported to be ineffective and might make students dislike mathematics more, regardless of whether they were the students being scolded or the well-behaved students. The following were the remarks made by some of the participants:

Because I was sitting in the first row, and the teacher was very strict with a fierce tone, I was very scared and didn't dare to speak out. For example, when I didn't understand something, I didn't dare to ask too much. (P18)

No, not helpful at all... they don't like mathematics even more. (P6)

Perhaps the least favorite thing is that when the teacher is fierce towards us, the mood is ruined. (P15)

Due to the more difficult mathematics syllabus in the secondary school compared to that in the primary school, some participants who had weak basic knowledge shared their feelings of frustration or stress when they were unable to understand or solve mathematics problems. The following were the remarks made by some of the participants:

The teacher starts teaching very quickly, and sometimes I don't understand. But because other students have already understood, the teacher will then moves on to the next question. (P18)

Because math problems require a calculation process and I have to keep solving them, if I encounter a problem I don't know how to solve, or suddenly can't remember how to solve it, I feel very frustrated. (P3)

When I was in elementary school, I was very poor in mathematics, and I just couldn't learn it properly. (P20)

In addition, more than half of the participants were nervous or worried about mathematics exams even when they had prepared well for them. Most importantly, such feelings about exams had caused some participants to make more mistakes in mathematics exams and therefore, negatively affected their exam performance. The following were the remarks made by some of the participants:

I feel very nervous because I was afraid that what I had reviewed before would suddenly be forgotten. I was also worried that I might fail the assessment and get a low score. (P10)

Well, probably yes. Because of nervousness, I might make careless mistakes, calculate incorrectly, or write words incorrectly. (P15)

Theme 2: Students' Attitude towards Mathematics

Throughout the interview, all participants had also shared their attitude towards mathematics, which can be categorised into affective aspect, behavioural aspect, and cognitive aspect.

In terms of affective aspect, 40% of participants expressed their enjoyment in learning mathematics, while 25% of participants had themselves or observed others feeling bored or sleepy during mathematics lessons. The enjoyment in learning math was mainly derived from the sense of accomplishment students experienced when solving mathematics problems successfully. The following were the remarks made by some of the participants:

It was boring at first because you couldn't understand what the teacher was saying, and you didn't know what to do. Even until the time when solving questions, you still didn't know how to solve the problems. (P16)

Because our class as a whole like mathematics lessons. We all think mathematics is very interesting, and following the steps to solve problems slowly feels very fun. It's like playing a game. (P12)

In fact, I think I enjoy it quite a bit, especially when I encounter difficult question. There will be a sense of accomplishment after solving it. (P2)

More than half of the participants had taken the initiative to learn mathematics where they would approach peers or teachers for clarification during math class, and some would do revision during free time at home or during recess time. Four participants on the other hand had chosen to give up when they were not able to solve the problem, and some had observed other students copy homework from others. The following were the remarks made by some of the participants:

*I will have to revise every day. When I get home and have time, I will do revise. (P11)
Maybe if I don't know how to solve a question, I just give up and don't attempt to solve. (P16)*

Well, they didn't fail to submit; they submitted late and they copied the answers in the morning. (P4)

Rely on a friend, because my deskmate is better at mathematics than me, so I sometimes ask him how to solve it. (P8)

Most of the participants agreed that mathematics is challenging but a useful subject for future endeavours. Five participants on the other hand perceived mathematics as a fun subject they enjoyed learning it. The following were the remarks made by some of the participants:

I think the math class is more fun, because every time you finish it, you will be very happy. Because when you do it, you will feel that you are very good after finishing the first question. (P14)

It's very complicated. I've heard many people say that it's a very simple thing, but I don't think so. (P6)

Maybe sometimes when I make some pastries myself, I may need some measurements and conversions, then it can be used. (P17)

Theme 3: Ideal Teacher's Characteristics

Most participants shared the characteristics of their ideal teacher when they were asked about the ideal mathematics learning environment. The ideal teacher is supportive, patient, and kind but firm.

Participants generally hoped to have a supportive teacher who would guide students individually and encourage students who were weak in mathematics to try their best to learn instead of giving up. The following were the remarks made by some of the participants:

The teacher will call on students to answer questions and then ask us to try solving them ourselves. If we are unable to do it, we can raise our hands and ask for help. (P1)

Because in the previous learning environment, when the teacher gave exercises, he would let us do them ourselves but walk around to check if we were doing them correctly. When he noticed students struggling, he would provide individual guidance. (P2)

The word "patience" was mentioned by more than half of the participants. They hoped to have a patient teacher who will explain the method of solving mathematical problems step by step and is willing to teach the same thing several times before proceeding to the next concept. The following were the remarks made by some of the participants:

Sometimes when the teacher asks if there are any questions, I raise my hand and ask. The teacher then comes to my seat and teaches patiently until I understand. (P10)

When we were in elementary school, the teacher would not get angry even if we kept asking and didn't understand how to solve a question. The teacher would patiently teach us how to do it, not just once but many times, and I think I could learn something this way. (P18)

Furthermore, participants hoped to have a teacher who is kind but firm someone who cares about students but at the same time maintains a certain level of orderliness in the classroom. It was their belief that students would be more disciplined when they were taught by such a teacher. The following were the remarks made by some of the participants:

Well, it creates a more relaxed atmosphere. It's not too serious, but there still needs to be a certain level of discipline. (P3)

There was a noisy student who used to be bad at math, but now he is quieter and more focused. He seems to have befriended the teacher during math class. (P6)

Theme 4: Feedback of Collaborative Learning in Math Class

Thirteen participants shared their experiences of having collaborative learning in their mathematics class. The benefits and challenges of collaborative learning were discussed.

Peer discussions and interactions with the teacher were reported to have improved understanding on mathematical concepts. Three participants even pointed out that collaborative learning helped to reduce discipline problems in class as students could participate more in the lesson. The following were the remarks made by some of the participants:

Because they were friends, the process of explaining will be more detailed. (P3)

But you still have to speak; you can only enjoy learning after you participate. (P4)

Most of them are more willing to listen to the class, concentrate, and many will take notes seriously. (P12)

However, three participants reported that a small group of students in the class did not participate during the discussion, while others reported students chatting during the discussion, which in turn disturbed the students who wanted to learn. The following were the remarks made by some of the participants:

It's more positive, but there are still some students who don't actively participate. (P17)

It may be because the deskmate is a good friend. At the beginning, it was about learning, but later they started to chat. (P10)

Theme 5: Lived Experience of Gamification in Math Class

Participants also shared their experience of gamification during mathematics class, including the benefits and the practical execution of gamification they perceived to be effective.

It was reported that using gamification in mathematics class had a lot of benefits. For example, gamification attracted students to be focused and motivated students to take the initiative to learn new concepts. In addition, using gamification might help to stimulate thinking among the students who originally gave up easily on mathematics tasks. The following were the remarks made by some of the participants:

If a certain material reward is given, some students will be more willing to learn. (P3)

It will attract attention because some games can be very tense. (P14)

I will teach them in a way that is more like a game, so they take class more seriously and reduce chatting with friends. (P10)

In terms of how the gamification should be carried out, participants shared experiences of the limited number of games they had in class. Compared to other forms of rewards such as verbal rewards, practical rewards were reported to be more effective. The following were the remarks made by some of the participants:

Sometimes he will take some time to play with us, like playing games that make everyone stand up. Then he calls on students one by one to answer a question within five seconds. If you don't answer correctly, you can't sit down; if you answer correctly, you can sit down. (P12)

Maybe if you get better grades, you may be rewarded with food. Or under certain conditions, the class may go out to play together, which is a favourite reward for secondary school students like us. (P2)

Theme 6: Best Teaching Practices for Basic Psychological Needs in the Math Class

Participants' responses on the ideal ways teachers should use in their teaching were categorized under the scope of satisfaction of basic psychological needs, including the need for autonomy, need for competence, and need for relatedness.

When learning new concepts or mathematics problems, providing different solving methods was reported to help improve learning as students can select the method they understand better, giving them a sense of autonomy. Using real-life examples helps to connect numbers and daily life, which were reported to have improved students' understanding and motivation to learn. The following were the remarks made by some of the participants:

It's like giving you many methods to solve a problem, and you can choose the one you understand best after trying each method. (P5)

I hope the teacher can use more varied question types, such as examples of how mathematics is used in daily life, to arouse the interest of students who find mathematics boring. (P2)

To satisfy students' need for competence, six participants shared how the sense of accomplishment experienced by solving mathematics problems motivates them to challenge themselves when trying to solve advanced questions. Four participants also suggested the use of simple questions in initially in order to help build competence in students who were weak at mathematics. The following were the remarks made by some of the participants:

If the first few questions are easy and the last few are difficult, students should not have much adverse reaction. Because they can answer more questions correctly, their stress level will not be too high. (P19)

Because when you finish solving a problem, you will get a sense of accomplishment, which motivates you to keep going. (P14)

In terms of satisfying the need for relatedness, almost half of the participants agreed that providing a fun environment could attract students to focus and learn, as students would more actively participate in the learning process. Furthermore, a caring environment where students help each other and the teacher being the guide was also suggested to have the effect of helping students to learn well. The following were the remarks made by some of the participants:

I hope the teacher is patient and asks whether we have really understood. Afterwards, when asking in private, the teacher explains in detail what we did wrong. (P18)

Yes. I think that if the teacher makes appropriate jokes, students can focus better on the teacher. (P11)

DISCUSSION

The present study which uses a mixed-study approach is aimed at examining the level of mathematics anxiety and mathematics intrinsic motivation among Chinese Independent Secondary School students in Malaysia. In addition, it also explores the students' lived experiences in the mathematics classrooms and their perspective of the ideal mathematics learning environment.

Mathematics Anxiety

The findings from the present study have revealed a similar level of mathematics anxiety, that is at a moderate level, as was the case in past studies of other Malaysian secondary school students (Omar, 2022; Puteh & Khalin 2016; Thien & Ong, 2015). However, more than 20% of the participants in the present study were found to have a high level of mathematics anxiety. As mathematics anxiety was reported to have affected students' mathematics achievement (Ashcraft & Krause, 2007; Barroso, 2024; Schukajlow et al., 2023), such prevalence of mathematics anxiety among Malaysian secondary school students may explain the low scores in international mathematics assessments.

Mathematics Intrinsic Motivation

Similar to mathematics anxiety, the prevalence of mathematics intrinsic motivation in the present study is worth noting. In the present study, Chinese Independent Secondary School students in Malaysia had only moderate mathematics intrinsic motivation, with 24% of the students having low mathematics intrinsic motivation, which was higher than the percentage of students having high mathematics intrinsic motivation (20%). As proponents of mathematics intrinsic motivation have claimed to be able to predict mathematics achievement (Atit et al., 2020; Baker, 2023), this perspective may provide an explanation for Malaysian students' low mathematics achievement as pointed out in past studies.

Factors Affecting Mathematics Anxiety and Mathematics Intrinsic Motivation

In sum, the quantitative study in the present study has revealed the prevalence of mathematics anxiety and mathematics intrinsic motivation, a pressing concern that has to be addressed. The qualitative data, on the other hand, can be used to explain the underlying factors causing the prevalence of the two issues in mathematics learning.

Traditional Teaching Method

Based on participants' responses, the teaching modality used by teachers has been found to be very similar to traditional teaching methods, as these have been defined in the present study; where teachers are the instructors and knowledge givers while the students are passive learners (Hossain et al., 2012). The results support findings in past studies, thus showing that traditional teaching methods still dominate in Malaysian secondary schools (Azar & Tan, 2020; Chin et al., 2022; Mohd Radzuan et al., 2023).

Such a teaching modality as has been experienced by students in the present study is reported to result in a negative mathematics learning environment, where students feel bored or stressed when learning mathematics. Studies on mathematics anxiety and mathematics intrinsic motivation by Azuan and Rosly (2025) and Irmayanti et al. (2025) have reported similar challenges faced by students who had experienced the negative effects of a traditional teaching method.

Advanced Syllabus Used in the Secondary School

In addition, due to the transition from a primary school to a secondary school, which means having to use a more advanced mathematics syllabus (Ramirez et al., 2018), a great number of participants reported feeling frustrated or stressed when struggling to understand the complicated concepts and questions in mathematics, and most of them reported feeling nervous or worried about exams, resulting in making more mistakes during the exams. This finding supported the vicious cycle between mathematics anxiety and mathematics achievement as suggested by Namkung et al. (2019) and Pellizzoni et al. (2022), where poor achievement elicits mathematics anxiety, which in turn causes further decline in performance.

Negative Attitude towards Mathematics

Internal factors such as students' attitudes towards mathematics were found to play a role in explaining the prevalence of mathematics anxiety and mathematics intrinsic motivation. While participants believe mathematics is challenging, they react differently based on their attitudes towards mathematics.

Negative attitudes towards mathematics were found to have led to lower mathematics performance or increased mathematics anxiety (Akin & Kurbanoglu, 2011; Hernández de la Hera et al., 2023), while attitudes towards mathematics were said to be positively related to mathematics intrinsic motivation (Mata et al., 2012). The present study supported such findings, as in the qualitative interviews almost all the participants who had low mathematics intrinsic motivation or high mathematics anxiety expressed negative attitudes towards mathematics, such as feeling bored or sleepy, and giving up easily during their mathematics class. On the other hand, those who had high mathematics intrinsic motivation or low

mathematics anxiety held positive attitudes towards mathematics, where they enjoyed learning mathematics and experienced a sense of accomplishment during the learning process.

Interestingly, despite having opposite attitudes towards mathematics, almost all participants reported doing revision during their free time and took the initiative to approach peers or teachers for clarification. This may be attributed to the belief held by participants that mathematics is a useful subject and this has helped to increase their motivation to learn (Otoo et al., 2018).

Solutions for High Mathematics Anxiety and Low Mathematics Intrinsic Motivation

Based on participants' responses regarding their ideal mathematics learning environments, three solutions can be suggested to improve students' levels of mathematics anxiety and mathematics intrinsic motivation.

Satisfying Basic Psychological Needs

Multiple teaching practices were suggested by the participants throughout the interviews, and most of their suggestions were related to the satisfaction of basic psychological needs. Participants in the present study reported that satisfaction of basic psychological needs helped them to increase motivation, reduce their anxiety, or improve their overall mathematics learning, all of which are in line with findings from past studies (Durmaz & Akkus, 2016; Patall et al., 2010; Ryan & Deci, 2020). These findings indicate the importance of considering students' needs when designing teaching modalities.

Student-Centered Teaching Modalities

Gamification, defined as the incorporation of game elements in non-game settings (Deterding et al., 2011), has been frequently discussed in the past decade (Chan et al., 2018; Dignan, 2014; Sotto, 2023). Findings from the present study supported the use of gamification in the mathematics class. Gamification is reported to attract and motivate students to learn and even stimulate their thinking. However, only a few participants had experienced gamification in the math class, and only a few game elements were incorporated in their lessons. This finding may indicate the lack of gamification training among education practitioners, which may also explain why the mainstream teaching modalities in schools still rely on traditional teaching methods.

It has been recommended that secondary students place more emphasis on peer relationships and learn from peers (Froiland & Davison, 2016; Schimmelpfennig, 2025). The use of collaborative learning may be suitable as it relies on collaboration between students and teachers. Based on participants' feedback on the use of collaborative learning, peer discussion or interaction with teachers during lessons were reported to have improved students' mathematics learning and had reduced discipline problems in the classroom. However, there was a lack of participation during class discussion, and some students had instead taken the opportunity to chat with their friends or classmates, a situation similar to the results showed in Cohen (1994), Janssen et al. (2007) and Sujatha and Vinayakan (2022). While the underlying causes were not identified during interviews, students' motivation in learning math may be the root cause of them not participating in the discussion, as has been suggested by Lowyck and Pöysä (2001).

Teachers with the Ideal Characteristics

While research has put much emphasis on the development of new teaching modalities, the characteristics of exemplary teachers are often neglected. Similar to the study conducted by Ansari and Wahyu (2017) and Yüksel-Şahin (2008), the present study has suggested that an overly strict teaching style is not effective and may cause adverse effects. A kind but firm teacher, on the other hand, was suggested to be more effective in dealing with issues on students' discipline.

In addition, the ideal teacher is seen as one who is supportive and patient during teaching, as this can maximize learning outcomes. These traits are very similar to the satisfaction of the need for relatedness, where a caring environment helps students to learn well.

Limitation and Future Research

The present study was a small-scale study focusing on students from Chinese independent schools, a specific context which may have a slightly different mathematics syllabus from the wider Malaysian secondary school system. Nevertheless, the study's findings have provided significant insights into the challenges faced by secondary students when learning mathematics. A larger-scale study can be conducted to collect more data from different types of secondary schools in Malaysia to broaden the scope of the findings.

In addition, while the present study collected both quantitative and qualitative data from students, teachers' perspectives were not included as they were not the primary concern in the present study. Future studies might want to explore teachers' ideas on the current and ideal mathematics learning environments, as these might provide more insights into the practical execution or challenges faced in their teaching.

Based on the results from the present study, there is indeed a need for future studies to develop and implement new teaching modalities to help students address issues with their mathematics anxiety and mathematics intrinsic motivation, alongside their mathematics achievement. Future studies may also focus on improving existing student-centered teaching modalities such as gamification and collaborative learning in order to maximize their design benefits for Malaysian secondary mathematics education.

Theoretical and Practical Implications

The present study has contributed to the need for conceptualizing the prevalence of mathematics anxiety and mathematics intrinsic motivation. The findings may raise awareness of these issues among educators and researchers and address the urgency to resolve these issues as soon as possible. Furthermore, findings from the present study could be used as references when similar studies are conducted in other types of secondary schools across Malaysia.

Moreover, by collecting qualitative data from students, the present study was able to shed light on the literature of educational psychology by capturing the challenges, factors, and solutions of mathematics anxiety and mathematics intrinsic motivation faced by Malaysian secondary school students. Such findings

are especially useful and can be a significant reference point when researchers or education practitioners are developing teaching modalities to improve students' mathematics learning.

In addition, the present study supports the use of student-centered teaching modalities and has provided the guidelines for the practical execution and the means of overcoming the challenges for educators to take note of when implementing such teaching modalities. These findings are especially important as they point out the importance of taking students' needs into consideration when school administrators and teachers are designing teaching modalities for mathematics learning.

Lastly, while the Malaysian government has increased the level of difficulty of the subject in the mathematics curriculum (Parkaran, 2022), Malaysia's mathematics achievement score in the latest PISA 2022 was still below the average score among OECD countries (OECD, 2023). Based on the findings of the present study, it has been recommended that instead of causing students to have higher mathematics anxiety and lower intrinsic motivation to learn mathematics, education practitioners shift their focus from changing the already-advanced mathematics syllabus to developing teaching modalities that can ease students' mathematics anxiety and increase their level of mathematics intrinsic motivation.

CONCLUSION

In conclusion, the prevalence of high mathematics anxiety and low mathematics intrinsic motivation among secondary school students in Malaysia means that education practitioners should take note of the underlying causes and that these issues of concern have to be resolved as soon as possible. The roots of this problematic state of affairs may be due to these factors: (1) traditional teaching methods, (2) advance mathematics syllabus, and (3) students' negative attitudes towards mathematics. There is a need for all relevant parties to shift their focus to developing student-centered teaching modalities that focus on satisfying students' basic psychological needs; with teachers given the proper training before they can effectively implement the new teaching modality that has been developed.

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Appendix A

Interview Questions Used in the Present Study

1. 你会如何形容你目前的数学学习环境？
(How would you describe your current mathematics learning environment?)

2. 你在数学课的时候感觉如何？
(How do you feel when you are in the mathematics class?)

3. 你在学习数学上下了多少努力？
(How much effort do you put in when learning mathematics?)

4. 你会如何形容一个理想的数学学习环境？
(How would you describe an ideal mathematics learning environment?)

Appendix B

Parents Consent Form (Qualitative Study)

Secondary School Students' Lived Experience in Mathematics Class and Their Ideal Mathematics Learning Environment

Identification of Investigators and Purpose of Study

Your child is being asked to participate in a research study conducted by Yap June Wei from HELP University. The purpose of this study is to explore secondary school students' lived experience in mathematics class and their ideal mathematics learning environment. This study will contribute to the researcher's completion of his PhD study.

Research Procedures

Should you decide to allow your child to participate in this research study, you will be asked to digitally sign this consent form once all your questions have been answered to your satisfaction and agree with being audio recorded throughout the research. In addition, your child will also be asked to digitally sign a child assent form if they agree to participate in the study. This study consists of a one-to-one interview that will be conducted in Microsoft Team during your child free time. Your child will be asked to provide answers to a series of questions related to lived experience in mathematics classroom and their ideal mathematics learning environment.

Time Required

Participation in this study will take not more than forty-five minutes to complete.

Risks

The investigator does not perceive more than minimal risks from your child's involvement in this study (that is, no risks beyond the risks associated with everyday life).

Benefits

Although there will be no direct benefit to you or your child for taking part in this study, your child's responses will help to increase current knowledge on secondary school students' lived experience in mathematics class and their ideal mathematics learning environment.

Confidentiality

Your child participation in this study is confidential. All your child's responses will only be known by the researcher, as well as the research supervisor. No one else will know your child's response. While presentation of findings may include individual quotes from your child, pseudonym will be used which can in no way identify your child as an individual. As such, there is no space for you or your child to note information that can identify your child as an individual like name or student ID number on the materials used in this study. All data will be stored in a secure location accessible only to the researcher. Upon completion of the study, all information that matches up individual respondents with their answers will be destroyed.

Name of Parent/Guardian (Printed)

Name of Parent/Guardian (Signed)

Date

Parent's/Guardian's Contact

Name of Researcher (Signed)

Date

Appendix C

Child Assent Form (Qualitative Study)

Secondary School Students' Lived Experience in Mathematics Class and Their Ideal Mathematics Learning Environment

My name is Mr. Yap June Wei. I am doing a study to try to find out the experience of students at your age in learning mathematics and their ideal mathematics learning environment.

If you agree to be in this study, here is what will happen: I will set up a one-to-one online interview with you in Microsoft Team during your free time. I will ask you some questions related to your experience when learning mathematics, and how you would like to learn mathematics. There are no right or wrong answer because this is not a test. The whole interview will be audio recorded. It will take you about 45 minutes to finish the study.

You can ask questions about the study at any time. Also, if you decide you don't want to finish, you can stop whenever you want.

You should talk this over with your parents before you decide to be in the study or not. I will also ask your parents to give their permission for you to be in this study. But even if your parents say "yes", you can still decide not to do this.

Digitally signing this paper means that you have read this form, or had it read to you and that you want to be in the study. If you don't want to be in the study, don't sign the paper. Remember, being in the study is up to you. No one will be mad if you don't sign this paper or even if you change your mind later.

Your signature: _____ Date: _____

Your name: _____