# Exploring A-level mathematics teachers' teaching practices and use of technology

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**ABSTRACT**

Student-centered teaching methods and technology are often viewed as effective tools to raise students' performance and interest in mathematics learning. Limited research exists on discussion of teaching methods and the use of technology on the general certificate of education (GCE) A-level mathematics. The purpose of this qualitative research where data were collected using semi-structured interviews was to explore how A-level mathematics teachers used teaching methods and technology for the delivery of mathematics instruction. Convenience sampling was applied, the participants were seven A-level teachers from a private college in Johor, Malaysia. The gathered responses were analyzed using thematic analysis based on the approaches suggested by Braun and Clarke. The findings of this research reported that while mathematics teachers revealed they made some attempts in incorporating technology and student-centered teaching approaches to their classes, traditional teaching approaches such as chalk-and-talk and drill-and-practices remained to be the dominant teaching approaches they would use in their classes. In order to have a closer examination between the relationship of students' interest and students' performance in mathematics, the researcher suggests the future direction of study on the development of a teaching module which serves as a reference guide to alleviate the mentioned teachers' concerns.



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## 1. INTRODUCTION

Behaviorism, or behaviorist teaching methods are one of the most commonly applied teaching methods in areas which involve a "correct" response, such as preparing for an examination [1], [2]. In the context of teaching and learning of mathematics, behaviorist teaching methods typically involve the teacher providing students with an "appropriate" response, which students would repeat until they have mastered the task [3], [4]. Behaviorist teaching approaches have become the dominant teaching approaches as stakeholders such as government, school, or even parents continue to push for "correct answers", in order to raise test scores [5].

In a survey conducted by Pampaka [6], where 13,516 secondary students were investigated about the kind of activities students experienced in mathematics lessons, "high transmission" activities such as teacher-led traditional activities were reported as the most frequently used practices in classroom. Pampaka attributed the increasing frequency of traditional learning activities to exams and time constraints teachers have to cover the content of the curriculum [6].

For mathematics, the main emphasis in schools is on the procedural knowledge of mathematics, which involves understanding of a series of steps to solving the mathematical problems. Inevitably, traditional teacher-led instruction such as direct instruction, rote memorization, drill and practices are involved to focus on solving guided practice questions. On several incidences, mathematics teachers even expressed the concerns that their students had been made into robots to be squeezed as many marks as possible out of an examination without understanding mathematics and realizing the importance of mathematics in our daily lives [7]. If students have difficulties in comprehending the need to study mathematics, or they fail to see the connection between mathematics and real-life problems, then it is not surprising to find out that students' affective emotion such as interest towards the subject would also be in a declining trend.

Students' interest in learning is viewed as one of the internal factors that affects students' performance [8]. In general, students who manifest greater interest in mathematics, their mathematics performance are usually better, although the relationship may not always be strongly correlated [9]. Students' interest should be studied more thoroughly especially at secondary or post-secondary education. In a cross-sectional study of examining students' attitudes towards mathematics, students' attitudes towards mathematics were reported to be in the declining trend from primary to high school education [10]. This could be due to the increasingly more abstract mathematical concepts involved in advanced mathematics, which prompts teachers to explain the conceptual and procedural knowledge of mathematics through direct instruction, thus further reducing students' interest in learning mathematics [11]. In the teaching and learning of mathematics, in addition to teaching conceptual reasonings and procedural problems solving methods, we shall also not underestimate the importance of interest in mathematics learning as interest influences students' learning and performance on assessments in mathematics [12].

Based on a report by trends in international mathematics science study (TIMSS) in 2015, Malaysian students remained to be at the low international benchmark [12], part of the reasons was resulted from the students' inabilities to solve higher order thinking questions [13]. On the quest in investigating the difficulties in inculcating higher order thinking skills from the secondary schools' mathematics teachers' perspective, Salleh identified lack of interest regarding higher order thinking skills questions as one of the factors students chose not attempting those more challenging mathematics questions [14]. In other words, students' lacked of interest in mathematics contributed to their weak mathematics performance.

In Malaysia, a student is required to join a post-secondary or pre-university program prior to entering tertiary education. Among the pre-university platforms available to Malaysian post-secondary school students, several pre-university programs are more exam-oriented, such as external examination focused *Sijil Tinggi Persekolahan* Malaysia (STPM) and general certificate of education (GCE) A-level. On the other hand, there are also post-secondary options which placed heavier focus on the internal assessments and coursework, thus less exam-oriented programs, such as International Baccalaureate IB Diploma and foundation programs offered by various universities [15].

It is not a surprising revelation that students who study exam-oriented programs will involve themselves in a more teacher-centered learning environment to build their knowledge. In a case study to examine the effect of rebranding of STPM, also known as Form 6, Ngang and Mei posited that Form 6 teachers still spoon-fed their students and Form 6 students did not get a lot of opportunities to undergo student-centered learning [16], [17]. Other than STPM, GCE A-level is also another grade-12 equivalent linear qualification that is popular among post-secondary students in the world, including Malaysian students, especially in the private sector. Under the linear structure, the subjects' content was viewed as a whole where learners are going to sit a set of terminal examinations at the end of the course [18]. The research on the teaching and learning styles on GCE A-level are limited and often obsoleted. However, in a research to identify the factors that affect students' performance in GCE A-level mathematics, Jayasinghe and Silva stated that students' enjoyment and teachers' uses of modern teaching methods have direct and positive relationships in affecting students' performance [19].

While traditional methods have been valued, there is a growing appreciation for an adjunct approach using educational intervention to promote students' interest in learning. Previous researchers proposed a four-phase model to promote students' interest development, which comprises attention-getting settings, contexts evoking prior individual interest, problem-based learning, and enhancing utility value. Out of the four phases, problem-based learning is seen as one of the alternative teaching methods to trigger students' interest in learning [20]. On the other hand, the provision of student-centered learning environment also has been shown to have a positive impact in improving students' affective domain. In a study to compare the changes of students' affect in between direct instruction and cooperative learning strategies, cooperative learning strategies generated stronger positive changes in students' interest as compared to direct instruction [21].

In addition to alternative pedagogies, technology is also proposed as another promising tool to grab students' attention and elicit students' interest in learning. Technology is used and integrated in different aspects of mathematics education, including the content delivery as well as the assessment [22]. In the publication of Measuring Innovation in Education published by organization for economic co-operation and development (OECD), it was reported that using digital devices for practicing and drilling for mathematics captivated students' interest as it enables the students to relate course material to real life situations [23].

In a study to understand educators' perceptions of technology integration into the classroom, Hartman, Townsend and Jackson revealed that educators agreed with the positive impact technology brought into their lessons. On top of that, educators, in general, are excited the potential of technology to enhance learning [24]. However, lack of training which resulted into the superficial level of technology integration is often reported to be one of the main obstacles to effectively utilize technology into their teaching [25].

Based on the well-recognized unanimity that teachers contribute significantly as a determining factor when it comes to student learning [26], there is a significant relationship between the method of teaching to student learning approaches. In the discussion about alternative approaches other than teaching that primarily involves traditional teaching methods, student-centered learning and technology integration are encouraged because these approaches promote students' participation as well as raise their interest learning among the students [14]. As one of the only few programs which still retains 100% external public examinations, A-level program is often criticized for promoting examination-oriented pedagogy [27], which focuses on drill and practice. As a result, it is noteworthy to examine the teachers' perspectives about which pedagogy and technological tools are most effective when teaching an A-level syllabus.

This study is based on a qualitative research design focusing on the main research objectives: to investigate the most applied teaching approached by A-level's teachers and to examine teachers' view on technology integration in order to maintain students' interest in learning mathematics. It is important to understand teaching approaches A-level teachers are applying and their views on alternative teaching approaches and technology because students' attitudes towards learning depends on the way teachers approach the subject matter. The research questions guided our study: What are the most applied teaching approaches implemented by the A-level's mathematics teachers? How are the teaching approaches and the technological tools being used in the classes used to maintain or stimulate students' interest in learning mathematics? This study provided a better understanding of teachers' concerns in terms of utilizing different pedagogy and technology in delivering mathematics content for their GCE A-level students.

## 2. RESEARCH METHOD

This study employed qualitative research design where semi-structured interviews to explore methods of teaching used by GCE A-level teachers from a private college in Johor. Johor is a state of Malaysia located in the South of Peninsular Malaysia. The private college is chosen as the sampling site due to the following reasons: i) It was reported that teachers from the private college predominantly employed traditional teaching methods to prepare students for examination [28]; ii) It was reported that pre-university teachers from the private college employed technology only at a superficial level [29]. However, was unclear what kind of pedagogy and technological tools that the mathematics teachers from the private college have been employing [28], thus, it is worthy to understand the types of teaching methods and technology being utilized by mathematics teachers in that college.

As we have narrowed down our sampling site into mathematics subject of the GCE A-level program from a private college in Johor, the researcher has invited mathematics lecturers who are willing to participate and have taught or currently still teaching GCE A-level program to provide the information by virtue of experience or knowledge [30]. In total, seven mathematics lecturers agreed to participate the interview. The interviews were conducted during the period of recovery movement control order (RMCO). Before the interviews were conducted, all participants gave written informed consents for their information to be recorded and analyzed for this work.

### 2.1. Four-phase process IPR framework

To improve the quality of data obtained from semi-structured interviews, the researchers incorporated the four-phase process interview protocol refinement (IPR) framework [31], [32]. The IPR framework is a four steps process summarized by the following: i) Ensuring interview questions align with research questions; ii) Constructing an inquiry-based conversation; iii) receiving feedback on interview protocols; iv) Piloting the interview protocol. These rigorous steps, if adhered, can better refine the research instrument more appropriately and coherently with the research objectives [31].

#### 2.1.1. Step 1: Ensuring interview questions align with research questions

The first phase involved alignment of interview questions with research questions. This safeguards the weight of every research question is the same and eliminate unnecessary questions. In this study, the first research question (RQ 1) is to investigate what and how are the teaching approaches implemented by the

A-level's mathematics teachers. On the other hand, the second research question (RQ 2) is to examine what and how are the technological tools that are being used in the classes. The questions are tabulated into an interview protocol matrix as shown in Table 1.

Table 1. Interview protocol matrix

| | | Background information | RQ 1: What and how are the teaching approaches implemented by the A-level's mathematics teachers | RQ 2: What and how are the teaching approaches implemented by the A-level's mathematics teachers |
|---|---|---|---|---|
| I. Introduction | Question 1 | X | | |
| | Question 2 | X | | |
| II. Pedagogy | Question 1 | | X | |
| | Question 2 | | X | |
| | Question 3 | | X | |
| | Question 4 | | X | |
| III. Technology | Question 1 | | | X |
| | Question 2 | | | X |
| | Question 3 | | | X |
| | Question 4 | | | X |

The mapping of the interview questions ensured that the research questions are covered by the interview protocol. The researcher intended to begin the interview by asking some introductory and generic questions relating to teachers' educational background and teaching experiences. The findings of this section are intended to provide insights in teaching methods employed in GCE A-level mathematics teaching. The main research questions include two categories, which are pedagogy and technology. If we split the research question in terms of categories, the weight of each category is the same amount, and it is reflected by the same number of questions per category of pedagogy and technology. This ensured that potential information gap due to the unequal weight of interview questions on one category can be minimized [31].

#### 2.1.2. Step 2: Constructing an inquiry-based conversation

Castillo-Montoya posited that research questions need to be reconstructed into colloquial inquiry-based interview questions that could promote conversation and trigger respondents to provide inputs on the area of study [31]. In preparing the interviews, the researcher included a short list of probing questions that were dependent on the interviewees' responses [32]. On top of these inquiry-based conversations, the researcher also added further probing questions at suitable occasions. For example, when teachers are asked "Why did you use technological tools?" some respondents had not used technological tools before and thus were unable to answer the questions. After pilot test, the researcher modified the question into "Have you used any technological tools to achieve the teaching objectives?" Depending on the "*yes*" or "*no*" response to the previous question, the different subsequent questions of "*please share an example of how you have used these technological tools*" or "*Please share the reason why did you not use technological tools*" ensued. These interactive questions allowed the researcher and respondents to have meaningful discussion in the context of the study [32].

#### 2.1.3. Step 3: Receiving feedback on interview protocol

Phase 3 of IPR framework is to receive in-depth input on the interview protocol from the field experts. Expert review provided formative feedback on how the study could be improved as well as summative feedback on how the collected data could answer the research questions [31]. In this study, two experienced researchers whose expertise were in the field of educational psychology reviewed the interview protocol, interview questions, and the writing style. At the end of this phase, the researcher adjusted the structure of some questions for a smoother flow of conversation.

#### 2.1.4. Step 4: Pilot test the interview protocol

In a review on interviews in conservational science research, Young *et al*. pointed out the questions in an interview were usually not carefully designed if pilot test had not been conducted. They have also identified there was only a mere 11% of papers out of the 227 papers reviewed stated the use of pilot interviews to improve the quality of subsequent interviews [32]. Pilot test was normally conducted before the carry out of a full-scale study [33]. In this study, one of the GCE A-level's mathematics teacher was recruited for pilot study in order to test the appropriateness of the questions. The feedback from the pilot study confirmed the appropriateness of the questions and assisted the researcher to identify and correct several flaws in the questions. In a nutshell, the pilot study allowed the research to make necessary adjustments on the interview protocol as well as interview questions for the subsequent interviews.

### 2.2. Participants' profile

Prior to interviewing the GCE A-level's mathematics teachers, an informed consent was also sought from the management of the private college involved. For this study, the researcher interviewed a total of seven mathematics teachers from the private college who had or currently having the opportunities to teach the A-level program. The demographic characteristics of the participants are tabulated in Table 2. Pseudonyms were used keep to identities of the interviewees to be anonymous.

Table 2. Profile of participants participating the semi-structured interviews

| No | Pseudonym | Highest qualification | Teaching experience |
|---|---|---|---|
| 1 | A | Master's degree | 4 years |
| 2 | B | Master's degree | 11 years |
| 3 | C | Master's degree | 6 years |
| 4 | D | Master's degree | 9 years |
| 5 | E | Master's degree | 5 years |
| 6 | F | Master's degree | 7 years |
| 7 | G | Master's degree | 3 years |

The researchers recorded the interviews with each participant using the recording application on the researcher's mobile phone. Due to the consideration of the participants' other commitments, the lengths of each interview were controlled so that each of it was in between 15 to 17 minutes. The interviews were conducted during the period of RMCO. Thus, the interviews were conducted in the campus while strictly adhering standard operating procedures for social distancing.

For keeping the records of the interviews with easy accessibility, the researcher transferred the audio-recorded interviews to the software Amberscript and began the verbatim transcription process. Amberscript is an audio transcription software which not only generates texts based on speech recognition but also allows user to edit the automatically rendered file for accuracy check to correct errors due to mispronunciation or inaudible passages. To establish validity and reliability of this study, the researcher returned the interviews' transcripts to the participants for them to comment on the accuracy and completeness of the transcriptions. This is in line with suggestions made by Noble and Smith to ensure the credibility of the qualitative study [34].

After the data collection, the data analysis step ensued. To derive insight from the collected interviews, the researcher conducted thematic analysis to code the data, make sense of the data, as well as synthesize the data into several themes or concepts [35]. Thematic analysis helps the researcher to examine the similar and different perspectives of different participants, to produce a well-organized report which discussed key features of the collected data [35], [36]. In this study, the researcher used NVivo to analyze findings and adopted the iterative, six-phased thematic analysis framework as documented by Braun and Clarke. The six-phase process are: i) Get familiar with the data; ii) Produce initial codes; ii) Identify themes; iv) Review themes; v) Define themes; vi) Generate the report [36].

## 3. RESULTS AND DISCUSSION

The researcher began the analysis in an inductive manner by first becoming more familiar with the data. Then, initial codes have been produced through a recursive process of coding, encoding, and recoding [36]. After that, the researcher began the iterative themes identification, theme review, and theme definition phases. These phases included combining various codes to form the overarching themes, identification of sub-themes (if there is any), and refinement of the themes. The researcher used thematic map to organize these codes into a range of themes, as well as illustrate the relationships among the different distinguishable themes [36]. A thematic map showing the final themes for this study is demonstrated in Figure 1. Details of themes are reported in the following section.

From the gathered responses as well as the thematic map produced, the researcher observed two emerging themes from the data collected and these themes help to answer research questions that have been guiding this research. In terms of answering why GCE A-level teachers used the teaching approaches they have been employing, the theme of pedagogy was discovered, subthemes of reasons of using traditional teaching methods, teachers' perspectives in improving the current practices were acquired. To answer what and how technology was being used in class, technology was identified as the other theme, where reasons of using technology, and teachers' perspectives in improving the current practices were acquired. The following sections detail the participants' views on how they have used different teaching approaches in the aspects of pedagogy and technology to deliver mathematics contents for GCE A-level's students.

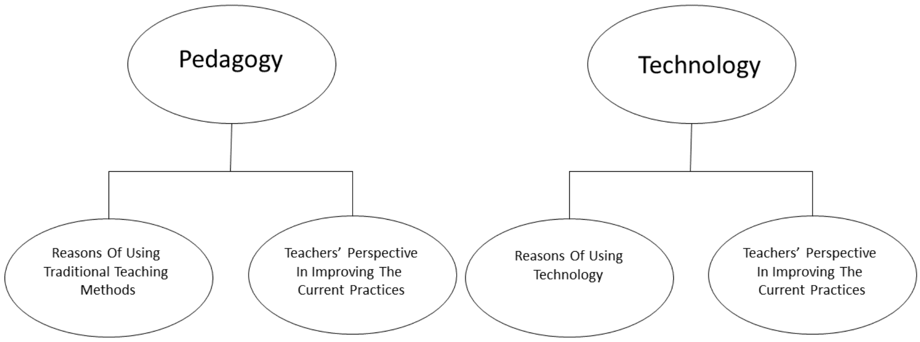


Figure 1. Thematic map

### 3.1. Pedagogy

The descriptions, examples, and frequencies of subthemes relating to pedagogy are tabulated in Table 3. Based on the responses collected, the researcher could divide the main theme of pedagogy into two subthemes. The themes are reasons of using traditional teaching methods and the teachers' perspective in improving the current practices.

Table 3. Descriptions, examples, and frequencies of subthemes relating to pedagogy

| Theme | Description | | |
|---|---|---|---|
| Pedagogy | The teaching practices or methods employed by GCE A-level teachers. | | |
| Subthemes | Description | | |
| Reasons of using traditional teaching methods | Reasons for using traditional teaching methods in delivering GCE A-level's mathematics content. | | |
| | Description | Examples | Frequency |
| | Due to students' experience | *"I used traditional method that involves chalk-and-talk as this method allows students to memorize easier. It is because students are used to this kind of teaching method since secondary school…"* (Participant D) | 3 |
| | Due to program's nature | "*…the very main objective for these A-level students is to take the exam…"* (Participant G) | 4 |
| Teachers' perspective in improving the current practices | Limitations of traditional teaching methods from teachers' perspectives. | | |
| | Description | Examples | Frequency |
| | To raise students' interest | "*…students find it dry to do past year questions"* (Participant B) | 4 |
| | To connect mathematics to real-life events | *"Some students become more interested at mathematics after knowing the connection of mathematics to real life events"* (Participant E) | 3 |

#### 3.1.1. Reasons of using traditional teaching methods

Based on our finding, traditional teaching approach is still the dominant teaching approach used by GCE A-level mathematics teachers from the college. Among the traditional teaching methods, chalk-and-talk, note-taking, and drill-and-practices are the most frequently employed teaching methods. This group of teachers reported students' experience and the program's nature as the two determining factors which affected their choice of pedagogy. In terms of students' experience, some teachers felt traditional teaching methods such as chalk-and-talk to be an effective teaching measure because students had been used to be spoon-fed with information in their formal education prior to GCE A-level. As participant D stated "*I used traditional method that involves chalk-and-talk as this method allows students to memorize easier. It is because students are used to this kind of teaching method since secondary school…*." Incidents of traditional teaching methods such as drill-and-practice and note-taking were also reported in the words of the participants. Participant F explained "*I show summary of learning content using PowerPoint and then present some examples to students. Then I will have students to work on more past year questions (PYQs), …, if students are very weak, I will give them more PYQs for practice*." Participant B elaborated how note-taking was applied in his mathematics classes, "*…I would give students my lecture notes and request students to complete the note… I used chalk-and-talk to teach new concepts.*"

The second reason for teachers to limit their practices primarily with the traditional teaching approach was because these practices fitted the program's nature and students' expectations. Since GCE A-level is a 100% exam-based program with plenty of topics involved, teachers decided to use mostly direct instructional approaches in their lessons to complete the packed syllabus within a tight schedule. As participant D elaborated on this, "… *A-level program is 100% external examination based, so students need to memorize everything….*" In a similar vein, participant G pointed out the ultimate goal for A-level students is to attend the summative examination, "*...the very main objective for these A-level students is to take the exam…,*" as a result, teachers should focus on exam-related syllabus only, "*...this is A-level syllabus, we should not cover more than what they need to know for the exam ….*" Besides, students also demanded effective strategies and shortcuts to solve the questions so that they could do well in the exam, participant G put it as, "*...they just want to work on the questions in a repeated process so that they could 'memorize' the solution of a particular type of question ….*" Participant F also added her viewpoint that because of time constraint, direct instructional approach should remain as the primary teaching approach for A-level mathematics, "*...the challenges could be in our current program, timeline is a very crucial part, due to time constraint, we may not be able to apply too many different teaching approaches ….*" This viewpoint echoes with comment from participant D that certain A-level students' sole interest was to obtain good grade and mark, thus, these students did not prefer practices other than drill-and-practices, "*...students do not feel interested in game-based learning (GBL) because some of them think it is a waste of time, they prefer to do more exercises like how they experienced in secondary school ….*"

Based on the data, it is evident that the direct instructional approach of teaching and learning is rooted in GCE A-level mathematics classes. In the hope to perfect students' mathematical problem-solving skills, the focus in the class lied on the repetition of stimulus-response practices. On the other hand, the teachers also expressed that their primary teaching practices of direct instructional approach were shaped by GCE A-level's nature of 100% exam-based examination. As a result, their focus lied on: i) Complete the syllabus on time; ii) Provide more practices to students in the hope of better marks in examination.

#### 3.1.2. Teachers' perspective in improving the current practices

From the data collected, the researcher encapsulated students' interest and connection to real-life application as the rooms for improvement of their current practices. Teachers who were interviewed agreed that interest plays an important role in mathematics learning, particularly for low-performing students. Participant E said "*For low performing students, one of the reasons why their performance can't be raised up because they do not have interest in learning mathematics ….*" In addition, participant C professed that there was a direct relationship between students' interest and students' performance, in his words, he said "*... if students are interested in math learning, they are keener to learn, thus, their results will be better ….*"

Teachers claimed students' low interest in learning mathematics was due to their struggles with doing mathematics questions. Participant F said "*Students who have low interest in mathematics mainly because they do not know how to start off a question ….*" On top of that, the current teaching practices of drill-and-practices which were employed by the teachers could not motivate students enough to develop interest in mathematics. This could be reflected by participants B' statements that "*...students find it dry to do PYQs...*", as well as participant A's suggestion to make drill-and-practices to be more attractive to students, "*…when students are not interested in doing PYQs, turn those questions into GBL activities….*"

When the teachers were asked how would they raise their students' interest in mathematics learning, the group of teachers emphasized on connecting mathematics to real-life events. As participant D put it, "*…students lack interest because they do not know why they need to learn math, they can't see the connection between knowledge and real-life application ….*" Such statement was also echoed by participant E's comment of "*some students become more interested in mathematics after knowing the connection of mathematics to real life events.*"

Participant G exemplified his lessons of making connection to real-life events with hands-on mathematics activities such as small-scale experiment, participant G elaborated the benefits of connecting mathematics with daily activities in the following way, "*...the application-based learning allows students to have an idea why they learn the knowledge and how they are going to apply the formula in real life ….*" While participant C also focused on the relation of mathematics to real-life events in his teaching, participant C highlighted students' mathematical proficiency should first be revised and sharpened, "*…once they have basic techniques and knowledge, they should be encouraged to apply knowledge into real-life event ….*" The paragraphs suggested that students' interest in learning mathematics may be associated with mathematical connection ability, as well as students' performance in mathematics. Mathematical connection ability is *known* as the ability to see or use mathematics on other topics, increased mathematical connection ability may eventually lead to increased mathematical achievement [37].

### 3.2. Technology

The descriptions, examples, and frequencies of subthemes relating to technology are tabulated in Table 4. Based on the responses collected, the researcher could divide the main theme of technology into two subthemes. The themes are reasons of using technology and the teachers' perspective in improving the current practices.

Table 4. Descriptions, examples, and frequencies of subthemes relating to technology

| Theme | Description | | |
|---|---|---|---|
| Technology | The technological tools employed by GCE A-level mathematics teachers. | | |
| **Subthemes** | **Description** | | |
| Reasons of using technology | Reasons for using technology in delivering GCE A-level's mathematics content | | |
| | Description | Examples | Frequency |
| | To raise students' interest | "*I conducted activities using technological tools to let students feel mathematics can be fun…*" (Participant A) | 6 |
| | Dynamic opportunities for instruction | "*…It assists students to imaging what happens to the graph and volume…*" (Participant D) | 3 |
| Teachers' perspective in improving the current practices | Limitations of technology from teachers' perspectives. | | |
| | Description | Examples | Frequency |
| | Time consuming | "*…to convert math teaching material to online or through technology is challenging and it is really time consuming...*" (Participant B) | 4 |
| | Technology fluency | "*…we also need to allocate time to explore the technological tools because not everyone has the skills to use these tools fluently…*" (Participant G) | 2 |

#### 3.2.1. The reasons of using technology

While the previous part of the study indicated that the focus of teaching practices for GCE A-level was mainly on teacher-centered traditional teaching approaches, these mathematics teachers also mentioned the incorporation of technology in their teaching. The group of mathematics teachers reported the use of technology as a mean to raise students' interest. There were six out of seven teachers agreed that incorporating technology in the lesson may direct or indirectly raise students' interest in learning mathematics in the classes.

In the direct manner, technology is used as a medium or an aid to raise students' interest through software or GBL activities. Participant A claimed that while conventional teaching leads to boredom in classes, technology helps to trigger students' interest. Participant A stated, "*...students perceive mathematics as a difficult subject, so I use GBL to stimulate students' interest and technology to let students feel mathematics can be fun….*" Along the same line, participant C shared his observation on how students' interest got raised as technological tools were introduced to them, "*as students get to play the games online using the technological tools, they become more interested in learning*." Participant F also explained how technological tools was used as a complementary tool to further raise students' interest in building mathematics concept map, "*...I use a software to create mind map and technology helps students to access the mind map more easily, students show greater interest as compared to the traditional way of doing Math questions….*"

Indirectly, teachers endorsed that technology has become a necessary tool to engage the new generation of students. Therefore, if students were learning in an environment that incorporated technology, that would capture the interest of learners and create a more effective learning environment. Participant A described the current generation of students as "*they are born in the age of technology*." Participant E spoke from her observation that students nowadays were mostly addicted to mobile devices, thus, if students could be immersed in a digital learning environment, they would develop a positive attitude and thus a greater interest towards learning, "*students will feel happier and more interested doing the questions using a phone than on the paper*." The same viewpoint was also supported by the response given by Participant B, "*given new generation of students, students are more interested to have technology embedded in our teaching*."

In addition to raising students' interest in mathematics, teachers also described several scenarios where technology provided dynamic interaction to enrich learning. For examples, three teachers shared how they have used web-based graphic calculators or dynamic software package such as *Desmos* and *GeoGebra* to illustrate or visualize the concepts that students were learning from GCE A-level syllabus. As participant C said, "*I used Desmos to visualize 3D dimensions, and students could get an insight of how the equation is applied in different* scenarios." Participant D also gave a similar comment when asked how technological tools were incorporated in the classes, "*I used Desmos, Socrative, and other apps for visualization of the graph and ease the imagination process.*" Participant E also touched on creation of dynamic learning opportunity through technological tools, "*I have used Desmos to help students understand different kind of functions better, such as transformation of the function and sketching of the function ….*"

#### 3.2.2. Teachers' perspective in improving the current practices

While there are definitive advantages of using technology in mathematics teaching and learning process, teachers *also* listed down the areas of improvement of technology in the context of mathematics education. The most commonly reported issue about having to use technology in the classroom is the extra preparation time. Participant G rationalized that it would require the teachers too much time to learn, attempt, and apply different technological tools especially taking into account that the schedule for completing the program's syllabus is tight, "*If we spent too much time in technology or e-based learning, we may not have enough time to complete the syllabus*." Participants A, B, E, and F were also in the same position as participant G, they pointed out that not only technology integration required a long preparation time, the implementation of these technological tools was also time consuming, especially when compared with direct instructional practices. In this regard, participant E made a comparison to underline the inefficiency of technology integration, "*If a class was conducted using the conventional teaching methods, maybe we can finish ten questions as compared to finish only five questions using GBL*."

On top of that, teachers' fluencies on using the technology are another concern raised from the interviews. Some teachers argued the effectiveness of using technology to ease teaching and learning process as not all teachers had the same fluencies in using the technological tools. This could be reflected from participant G's comment, "*if we were applying technology in mathematics, it is a little bit harder because it is difficult to type the equation ....*" and participant E's observation on students' input "*not all the apps support mathematical expressions, it limited our ways to request students for input ….*"

## 4. DISUCCSION

This section begins with a summary of the findings of the study and their connections to literature followed by a discussion of implications and contributions of the study's findings for future research direction. To answer the research question, the findings from this study informed us why teachers do what they do in the classes. These reasons included students' past experience and students' expectation of teachers' teaching style, meeting the program's nature, raising the students' interest in learning, as well as providing dynamic learning opportunity for the students.

This study showed that teachers would modify their teaching approach to a more teacher-centered one because of their students' expectations or request. This was presented in participant D's description of the easiness of using chalk-and-talk because students were familiar with this kind of teaching approach. This was in line with the discovery made by Hassel and Ridout that first-year university students would anticipate teaching be delivered in the same way as they had experienced it at secondary school [38]. Findings from this study showed that teachers mainly employed direct instructional practices such as chalk-and-talk and drill-and-practices as the teaching approaches for GCE A-level students. The GCE A-level program's nature and time constraint were considered as the obstacles that hindered the application of other teaching approaches for GCLE A-level. This supported the report that high-stake examination such as GCE A-level exam takers experience a narrow range of methods of teaching and learning across their overall programs [39], [40].

Furthermore, teacher's unfamiliarity with content specific technological tools became one of the barriers preventing teachers from integration technology into instruction. Teachers' low technology familiarity is supported studies which could be traced back before COVID-19. In 2017, a study to explore the barriers to purposeful technology integration, Bodsworth and Goodyear found that unfamiliarity with technology to be the initial barrier while integrating technology into the lessons [41]. In a time of pandemic, Sahoo revealed that student teachers, as well as teachers faced difficulty in conducting an effective teaching and learning instruction because of teachers' unfamiliarity with techno pedagogical approaches [42].

On the other hand, findings from this study also reinforced the need to raise students' interest in learning mathematics. While teachers held different opinions on which type of teaching approaches could better simulate students' interest in learning mathematics, teachers generally agreed that students' interest and mathematics performance are positively correlated. In other words, if students' interest can be enhanced through the use various teaching approaches or technologies, this will eventually lead to increase of students' performance in mathematics, especially for the weak performing students. These findings corroborate with conclusion drawn by Wong and Wong who noted a significant relationship between interest and mathematics performance among students whose mathematics performance were considered as weak [43]. On the other hand, the inconclusive findings of the types of teaching approaches to raise students' interest may draw attention for the future direction of this study [43].

Furthermore, finding from this study show that the participating mathematics teachers (at least three of them) used technological tools or different student-centered approaches such as GBL or collaborative learning activities to deliver dynamic and interactive teaching content to their students. The high percentage of mathematics teachers using technological tools could be explained by the intermittent workshops provided to the college's academic team which aimed to encourage lecturers to shift the traditional pedagogy to technology integrated lecturers and assessments [44]. As indicated in the previous paragraph, timeline for GCE A-level program is tight and short, it is not surprising that some teachers might not be convinced of the educational benefits of technology. Thus, they decided not to use these technological tools in their classes. To address teachers' belief that teaching is ineffective, time-consuming, and unproductive, teacher education and professional development programs should be prepared.

While the findings contribute to the literature of pedagogical and technological practices observe among GCE A-level mathematics teachers, the researcher would like to discuss the limitation of the present study. As the sampling method was conducted through convenience sampling, this means that the findings are not generalizable on all teachers who are teaching GCE A-level from other colleges and institutions. In addition, this study focused on teachers who are teaching exam-oriented program, the insight derived from this context might not be applicable to teachers who are teaching non-exam-oriented programs.

## 5. CONCLUSION

This study demonstrated a full spectrum of views in the pre-university mathematics teachers' descriptions of their teaching approaches and use of technology for GCE A-level mathematics instruction. At first, teachers shared that traditional teaching approaches were used as the primary teaching methods for A-level program because of students' expectation and the high-stakes nature of the program. This revelation aligned with the premise that high-stakes examinations encourage the implementation of traditional teaching methods.

On the other hand, teachers acknowledged the importance of interest in improving students' performance in mathematics. Most of the teachers mentioned how they integrated student-centered learning activities and technology in their classes to stimulate students' interest in learning, in addition to making real-world mathematics connection to inspire students to learn. Nevertheless, the group of teachers shared the difficulties they faced in balancing the amount of time spent in interest-arousing activities and finishing the syllabus. Among the hardships, time limitation and technology fluency remained to be the main obstacles that impeded the widespread use of alternate pedagogy and technology by the teachers. Insufficient evidence for benefits of indirect instructional practices was also pointed out as the other reason behind why traditional teaching approaches were the mainstream teaching approaches used by A-level teachers.

Based on these reasons, the researcher suggests the direction for future research shall focus on investigating the effectiveness of pedagogy or technological tools in raising students' interest. For an example, future researcher may develop and evaluate a teaching module which serves as a reference guide for reinforcement activities that fits into the purpose of teaching. Not only the module may guide the teachers in selecting and implementing more "student-centered", interactive, and interesting pedagogical activities and technological tools for their teaching, it also will provide an opportunity for a closer examination between students' interest and students' performance in mathematics. In a nutshell, the development of a module to introduce useful pedagogical activities and technological tools for exam-oriented program such as A-level is proposed to be conducted in order to examine the relationship between students' interest and students' performance in mathematics.

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