PRE-SERVICE TEACHERS' PERCEPTIONS ON LEARNING MATHEMATICS REMOTELY

Persepsi Siswa Guru Terhadap Pembelajaran Matematik Secara Maya

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ABSTRACT

The COVID-19 pandemic caused educators to implement remote learning as students and educators began working online at home. While many studies reported the effectiveness of online learning, there is little research reported on its effects particularly in the context of learning mathematics remotely. Hence, this gap provided an opportunity to investigate the perceptions of pre-service teachers of the Institute of Teacher Education (IPG) on learning mathematics courses remotely. This survey research design involved 48 participants of IPG Temenggong Ibrahim Campus who underwent two mathematics undergraduate courses employed the purposive sampling method. An online survey was administered to gather their views about i) advantages; ii) challenges and how to overcome; iii) suggestions to improve remote learning. Content and descriptive statistics analyses indicated that learning experiences (79.2%), and flexibility (62.5%) were two prominent advantages in learning mathematics remotely. The greatest challenges faced were internet connection (66.7%) followed by understanding subject content (64.6%). In order to overcome internet connection issues, the participants mostly resorted to tethering, and subscribing to a better telco. Most of the participants addressed the latter challenge by referring to their lecturer, specifically asking questions, reread notes and review videos provided by their lecturer. Among the typical suggestions to improve learning were to utilise platforms that require less data consumption (25%), and provide more lesson videos (33.3%); while 35.4% were satisfied with the current approach employed by their lecturer.

Keywords: remote learning, learning mathematics, pre-service teacher.

ABSTRAK

Pandemik COVID-19 menyebabkan pendidik melaksanakan pembelajaran maya apabila pelajar dan pendidik mula bekerja secara dalam talian di rumah. Walaupun banyak kajian lalu yang melaporkan keberkesanan pembelajaran dalam talian, hanya beberapa yang tertumpu kepada pembelajaran matematik secara khusus. Jurang ini membolehkan suatu kajian dilaksanakan untuk mengkaji persepsi siswa guru Institut Pendidikan Guru (IPG) terhadap pembelajaran matematik secara maya. Kajian reka bentuk tinjauan ini yang melibatkan 48 peserta kajian daripada IPG Kampus Temenggong Ibrahim yang telah mengikuti dua kursus matematik menggunakan kaedah persampelan bertujuan. Suatu soal selidik ditadbir secara dalam talian bagi mengumpul pendapat mereka berkaitan i) kelebihan; ii) cabaran dan langkah penyelesaian; iii) cadangan mempertingkatkan pembelajaran maya. Analisis kandungan dan statistik deskriptif mempamerkan bahawa pengalaman belajar (79.2%), dan keluwesan (62.5%) merupakan kelebihan utama dalam pembelajaran jarak jauh. Cabaran terbesar terdiri dari rangkaian internet (66.7%) diikuti pemahaman kandungan (64.6%). Kebanyakannya mengatasi masalah rangkaian internet melalui 'tethering', dan melanggan perkhidmatan yang lebih baik. Masalah pemahaman kandungan pula diatasi dengan merujuk pensyarah, yakni bertanyakan soalan, membaca semula nota, dan menonton semula video yang disediakan. Cadangan penambahbaikan yang diutarakan adalah mengaplikasikan tapak yang menggunakan kurang data (25%), dan menyediakan lebih video pembelajaran (33.3%); manakala 35.4% berpuas hati dengan pendekatan sedia ada.

Kata Kunci: pembelajaran jarak jauh, pembelajaran matematik, guru praperkhidmatan

INTRODUCTION

Online learning has always been a part of learning and instruction, regardless from preschool to tertiary level of education. Online learning is often combined with a particular amount of face-to-face activities or better known as blended learning (Havemann, Charles, Sherman, Rodgers & Barros, 2019). There are many definitions of blended learning; nevertheless, the common themes that surround its definition appear to be a blend of delivery media, instructional methods and a combination of online and face-to-face instruction, in which, the third theme appears to be more accurate in context (Bonk & Graham, 2005). Besides blended learning, conventional instructional methods are still implemented as a mode of delivery by educators particularly in learning mathematics (Afandi, 2018).

Unexpectedly, the COVID-19 pandemic that affected the whole world, including Malaysia, forced educators to make the sudden switch from their current conventional and blended learning mode of instruction to remote learning. This sudden transition is now the new norm of learning as students and educators begin working online at home. Remote learning has become a requirement for the continuation of classes (IPGM, 2020). It becomes a necessity when geographical distances separate educators and students while a virtual classroom is the only avenue to connect each other.

Online learning can be conducted synchronous, asynchronous or a combination of both (Horvitz, Garcia, Mitchell, & Calhoun, 2019). However, it is important to determine the most feasible manner to utilise based on the topic of delivery. Besides that, Hodges et al (2020) highlighted that conducting remote learning during a crisis such as during the current COVID-19 pandemic is different from a planned remote learning environment. Thus, describing it as emergency remote teaching (ERT). This situation is somewhat true as instead of implementing a course or lesson that was initially designed with utmost planning for remote learning, the COVID-19 pandemic has led educators to a sudden switch from courses that probably use face-to-face interaction or blended learning to a full online mode. There might be a possibility that educators are struggling to make this switch as classes have to continue despite the cancellation of face-to-face classes.

While many studies reported the effectiveness of online teaching and learning, there is little research reported on its effect particularly in the context of learning mathematics remotely. The challenge is evident when learning mathematics remotely has to do away with conventional and blended learning but relies totally on a full online mode of instruction. It is important to note that the learning of mathematics is different from other subjects. Effective mathematics learning occurs when a student is able to connect cognitively the four forms of mathematical representations, namely: symbol, mathematically structured image, language and context (Haylock, & Cockburn, 1989). This involves employing and combining the various forms to understand a situation; which in turn, develops the understanding of mathematical concepts to enable students to move forward in their learning similar to building blocks.

Hence, the sudden transition to remote learning requires educators, as well as, students to adopt a new learning environment where these four forms of mathematical representations have to employed digitally. Wachira (2020) stressed that facilitating higher education mathematics is demanding and investigated how to leverage online learning environments and particular related digital tools to achieve the objectives for mathematics education. This scenario is also evident among pre-service teachers of the Institute of Teacher Education (IPG) who are also undergoing lectures through remote learning. It is important to highlight that many pre-service teachers come from suburban and rural areas from all over Malaysia; hence, the necessity to factor internet network bandwidth and availability towards the implementation of remote learning (Johnny, 2021). Many pre-service teachers of IPG are subscribed to a limited data plan on their smartphones while they also own a laptop. Hence, remote learning is possible but there is a possibility that lecturers may need to tailor their classes based on students' limited internet bandwidth, limited data plan while still customising to their students' capabilities.

The current pandemic situation that affected these pre-service teachers provides an opportunity to gain particular insights pertaining to learning mathematics courses remotely as IPG lecturers make the sudden switch to remote learning. However, the scope of this study is limited to the perspectives of pre-service teachers of IPG related to remote learning on mathematics courses. Hence, this study attempts to investigate the perspectives of pre-service teachers of IPG on learning mathematics courses remotely; which in turn, addresses the following research questions:

i. What are the advantages of learning mathematics remotely?
ii. How are the challenges faced when learning mathematics remotely?
iii. How to assist learning mathematics remotely?

METHODOLOGY

This study applied the survey research design. A purposive sampling method was employed to select the participants of this study which consist of pre-service teachers of IPG Temenggong Ibrahim Campus who underwent mathematics undergraduate courses remotely. The population comprises of 58 pre-service teachers who underwent two mathematics undergraduate courses, namely: Statistics and Linear Algebra. However, only 48 pre-service teachers participated in the survey and thus were engaged as participants of this study.

The main instrument used to collect data for this study consist of a survey that focused on four aspects:

i. Advantages of remote learning
ii. Challenges faced during remote learning
iii. How did the participants overcome their challenges
iv. Suggestions to ease the learning of mathematics remotely

Only four open-ended questions based on the above aspects formed the items of the online survey. The responses are to be based on the two mathematics courses that they underwent through remote learning during the Movement Control Order implemented by the government of Malaysia nationwide due to the COVID-19 pandemic. In order to better understand particular findings, the Learning Management System (LMS) in which the participants were enrolled in was also used as a document for reference.

Since there were no physical interaction with the participants, the survey was distributed online. It was administered at the end of the semester once the participants have completed all their credit hours. The participants were urged to type their views for each item with utmost confidentiality and to remain anonymous in order to ensure honest responses.
Although the items consist of open-ended questions, the responses by the participants were analysed using the quantitative approach through content analysis. This method of analysing data involves establishing the main categories of the data and identifying the frequency of occurrences of the particular categories (Joffe & Yardley, 2004). Although the survey items were established into four main aspects, they were organised into three main categories for conducting the content analysis, namely: advantages; challenges with solutions, and suggestions of learning mathematics remotely. The second and third aspects were merged into a category because the responses by the participants on how they overcome their challenges were closely related to the challenges that they faced which answers the second research question.

The second step in conducting content analysis was to observe emerging patterns in the data for each main category so that the data could be broken down into smaller codes to provide better clarity of the main category (Joffe & Yardley, 2004). Consequently, the data of the three main categories were then reviewed critically to be divided into smaller categories, labelled as subcategories and sub-

subcategories according to its context, as well as, correlating with the purpose of the study. The recurrence of similar subcategories was then calculated to determine its frequency in percentage.

In order to establish reliability of the analysis, two experts in content analysis were engaged to assist in the analysis of the data to ensure that each subcategory was consistently rated using a simple percentage of agreement. Based on the comparison between each rater's coding, the inter-rater agreement was valued at 95.1%. The findings were then delineated in accordance to the three main categories that also answers the three research questions.

ANALYSES AND FINDINGS

Advantages of Learning Mathematics Remotely

The content analysis extracted four subcategories from the participants' view on the advantages of learning the mathematics courses remotely, namely: learning experience; flexibility; accessibility and technological skills as described in Table 1.

Table 1

Advantages of Learning Mathematics Remotely

Advantage	Frequency (%)
Subcategory A1: learning experience (79.2%)	
Positive lecturer-student interaction	34.2
Time to work on tasks	29.0
Helpful	18.4
Explore independently	13.2
Self-discipline	2.6
Ability to discern	2.6
Subcategory A2: flexibility (62.5%)	
Study in own comfortable space	46.7
Study in own time and pace	43.3
Sufficient task	10.0
Subcategory A3: accessibility(25.0%)	
Helpful learning materials and resources	66.7
Able to pursue course	33.3
Subcategory A4: technological skills(12.5%)	

Learning experience was evidently the most significant subcategory with 79.2% of the responses finding the mathematics courses conducted remotely offered them better learning experiences. 34.2% from this subtheme response expressed their liking towards the positive lecturer-student interaction when learning mathematics remotely. The following are among the excerpts extracted:

a."...can ask many questions at the same time..." (R06, R08, R15, R23, R31, R33)
b."...ask questions freely because in the real class I feel shy to ask as I feel the question that I want to ask is easy for others. So with this online class, I can ask many questions to my lecturer." (R21)
c."...feels like one to one interaction with the lecturer and student." (R22)
d."...can keep in touch every day." (R35, R42)

Besides positive interaction, 29% felt that they had more time to work on and solve particular tasks provided by the lecturer; while 18.4% felt that the lessons conducted remotely were helpful to their understanding. A small number of this subgroup stated that learning mathematics remotely assisted them to explore subject content independently (13.2%), be self-disciplined (2.6%), and allowed them to better identify the areas of the subject content that they could not comprehend (2.6%).

Flexibility was the second most substantial theme with 62.5% of the responses finding the mathematics courses being much flexible compared to their previous face-to-face interaction. Most of the responses revolved around being able to study in their own time and pace (43.3%) and in their own relaxed and comfortable space (46.7%). About 10% of the responses stated that the tasks given by their mathematics lecturer was sufficient for the class duration and didn't cause a heavy workload as these participants had to assist their family in house chores as well.

Only a quarter of the respondents found accessibility as an advantage of remote learning. 33.3% of them were satisfied that they were still able to undergo their courses without delay when the Movement Control Order was issued; while 66.7% felt that the learning materials and resources provided were helpful. Among the excerpts extracted from the analysis are as follow:

a."There are more learning materials provided…" (R09, R36)
b."...many useful notes that can be referred to when doing online exercises (R11, R20, R39)
c."... can easily attach work..." (R11)
d."...can replay videos by lecturer..." (R19, R22, R41)

12.5% of the participants felt that learning mathematics remotely assisted them in improving their technological skills. Despite the various positive advantages indicated by all the participants, it is also necessary to highlight a finding from a participant who stated that learning mathematics remotely had no advantage. He expressed that the understanding of the Linear Algebra course content was "not really good" and he also found it "too difficult to ask questions". This feedback is essential to note as it provides an opportunity to understand students' difficulties in remote learning during this pandemic. This finding may also assist lecturers on how to further enhance the learning of mathematics generally, and the particular course specifically. The findings are tabulated in Table 1.

Challenges faced from Learning Mathematics Remotely and Solutions Used

The challenges that the participants faced when learning mathematics remotely consisted predominantly of internet connection issues (66.7%) and understanding the subject content (64.6%); while self-discipline, and media and resources being other challenges faced with a percentage of 8.3% and 6.3% respectively. Table 2 delineates the specific findings of each challenge extracted from the analysis.

Table 2

Challenges in Learning Mathematics Remotely

Challenge	Frequency (%)
Subcategory C1: internet connection (66.7%)	
Subcategory C2: understanding subject content (64.6%)	
Absence of face-to-face interaction	48.4
Text-based resources unhelpful	35.5
Lessons without video unhelpful	21.9
Subcategory C3: self-discipline (8.3%)	
Forgetfulness	50.0
Sleep	25.0
Procrastinate	25.0
Subcategory C4: media and resources (6.3%)	
Sharing of laptop	33.3
Laptop performance	33.3
Insufficient materials	33.3

The most evident internet connection issues faced by the participants of this study were weak, unstable and limited connections. In order to overcome the problem, the participants mostly resorted to using other internet options such as tethering (50%) and subscribing to another prepaid data plan with a better telco service within their vicinity (21.9%). There were 15.6% of this group of participants who moved around the house with their laptops in order to access a good internet connection. Meanwhile, another 15.6% of the responses indicated that the participants just waited until the connection recovered to continue their lessons. About 9.4% stated that they worked on their tasks immediately the moment they got a good connection any time throughout the day.

Based on the understanding the subject content subcategory, 48.4% of the responses indicated that the absence of face-to-face interactions impeded their understanding of the course content. 35.5% found that given notes and resources using merely texts were insufficient for understanding the particular subtopics. A related finding was also extracted where 21.9% of the participants found the use of lesson videos prepared by the lecturer being useful while subtopics without video accompaniment were difficult to understand. The most frequent solution used by the participants was related to referring to the lecturer. It consisted of texting or asking questions to their lecturer (35.5%) and repetitively going through their lecturer's notes and videos (22.6%). Besides that, the participants' responses also indicated that they search for online resources (22.6%); ask their peers (16.1%) and do more mathematics exercises (6.5%) to gain better understanding.

A small group of participants faced self-discipline issues that stemmed from the challenges in remote learning. Participants R14 and R17 admitted that they tended to forget their class schedule while being at home, hence missing lessons. R09 admitted that he faced difficulty to wake up early at home; while R08 tended to procrastinate tasks given by the lecturer. All of them began setting many reminders and alarms on their mobile phones; while one of the participants asked his peer to give him a phone call as a reminder so as not to miss classes.

In the aspect of resources being a challenge during remote learning, R30 said that she had to share her laptop with her younger school going siblings as all of them had classes conducted online. In order to solve this issue, she began writing down all the notes given by the lecturer in a book for convenient reference when her sibling used her laptop. R37 faced a low performance on her laptop; hence, she used her mobile phone alternatively despite having an uncomfortably small screen. R40 admitted that he did not pack any of his notes and books when the sudden rush to vacate their hostels and return home occurred. The solutions that the participants used to address their respective challenges are described in Table 3.

Table 3

Solutions to Challenges in Learning Mathematics Remotely

Challenges	Solutions	Frequency (%)
Subcategory C1: internet connection (66.7%)	Tethering	50.0
	Subscribe to another Telco	21.9
	Relocate	15.6
	Wait for recovery	15.6
	Work during good connection	9.4
Subcategory C2: understanding subject content (64.6%)	Ask lecturer questions	35.5
	Review lecturer's notes and video	22.6
	Online resources	22.6
	Ask peers	16.1
	Do more exercises	6.5
Subcategory C3: self-discipline (8.3%)	Set alarm	100.0
	Reminder phone call	25.0
Subcategory C4: resources (6.3%)	Copy notes	33.3
	Use smartphone	33.3

Suggestions to Ease the Learning of Mathematics Remotely

About 35.4% of the participants were satisfied with the way their lecturer conducted the mathematics courses remotely. The delivery of contents typically consisted of prepared notes using text and diagrams, and examples with solutions; self-prepared lesson videos with explanation on particular concepts and solving methods; real time discussion using an online interactive whiteboard; and sharing links of various online resources. These materials were uploaded on a LMS that the participants have been utilising even before the pandemic began.

33.3% of the participants suggested lesson videos to be provided in every class. According to the responses, it appears that the use of lesson videos enabled the participants to review the videos at their own pace to improve understanding. Besides that, it may also assist them to watch the videos when they have good internet connection. A quarter of the participants suggested that their lecturer utilise learning platforms that require less data consumption. A few responses indicated their preferences towards the use of WhatsApp and Telegram for conducting classes.

There were also suggestions on how to improvise the tasks given by their lecturer (22.9%). The responses indicated that the participants needed longer duration for task submission; tasks to be directly accompanied with an example and its solution for reference; more explanation; and to upload the task before the stipulated class schedule. 4 participants suggested that their lecturer provide lighter tasks; whereby they wanted easier tasks; tasks that involve reading materials; and tasks that can be completed within the class duration. Two participants requested for 'real time' lectures that use online meeting software; while another two hoped that their lecturer would be stricter with students' punctuality for classes.

Further Insights

This study identified that learning mathematics remotely managed to provide better learning experiences for most of the participants, particularly, in the areas of positive lecturer-student interaction and more time to solve tasks. The participants seemed to be satisfied that they were able to ask many questions and obtained feedback from their lecturer pertaining to the lesson of the day during class as well as out of the class duration. Questions, answers and feedback occurred both in their LMS and also through text messages to the lecturer involved. Allowing students to take their time to submit tasks was also helpful in their learning experience as there were participants who faced internet connection issues which led to delay in downloading and uploading resources.

Van den Berg (2018) highlighted that synchronous learning provides better interaction compared to asynchronous learning, which may cause students to feel isolated despite having the flexibility in learning time and space. Dumford and Miller (2018) also pointed out interaction quality as a constraint in online courses, particularly for students who undergo many online courses. These literature issues related to interaction between instructor and student may be true if remote learning is conducted synchronously. However, the outcome of this study indicating a positive lecturer-student interaction is possibly due to the participants engaging in remote learning that combines synchronous and asynchronous learning. Hence, this method might be a solution to assist students' learning experience; whereby, the participants felt that they were always able to keep in touch with their lecturer. Flexibility, on the other hand, is an expected outcome as previous studies too have reported that students being able to determine their own time and place for learning as an advantage in remote learning (de Oliveira et. al, 2018; Van den Berg, 2018; Borisova et. al, 2016).

It is also important to highlight that this group of participants has a great preference for lesson videos compared to real time video conferences. It was evident in the findings related to the participants' view on the advantages of remote learning. Similarly, findings also uncovered that the participants faced difficulty in understanding lessons that did not have video accompaniment. Participants also emphasised that notes using merely texts were insufficient for understanding. The proposition for using lesson videos also emerged in the suggestions by the participants for a better learning of mathematics

remotely. Literature also indicated that videos annotated with instructor notes tended to be a preference for students compared to slide shows (Williams and Gil, 2018). As most of the participants indicated internet connection as the greatest challenge in learning mathematics remotely, using lesson videos may possibly pave the way to a better remote learning experience for the participants undertaking mathematics courses.

However, it may be essential to also note the characteristics of the lesson videos used in this study that had possibly enticed the participants. The lesson videos prepared by the lecturer consisted of short videos within three to five minutes' duration that focussed on particular parts of the day's lesson, and not a whole lesson. For example, drawing a vector in space; performing addition of two vectors in space; reading the P value from a standard distribution table; determining the probability area below a normal curve and many other self-made videos. Hence, chunking the day's lesson into smaller parts using short videos may be helpful in student engagement. Besides that, students with limited internet connection may be able to conveniently download videos and follow lessons while downloading the next video.

Preparing lesson videos demands a large effort, time and possibly costs for educators. However, on a larger spectrum, this will not only overcome the problem of missing lessons due to internet connection issues and real time meetings, but also lead the way to a meaningful asynchronous learning and flexibility in learning mathematics. Borisova et. al (2016) stressed that lag time between student input and feedback might be a drawback in remote learning. This situation might also occur if lesson videos become the sole method of teaching remotely. Students may watch the video in their own time while lecturers may not be available at all time to answer their queries and provide necessary feedback. Therefore, it is still important to have a variety of materials apart from lesson videos when conducting remote learning. A planned schedule for classes would still be needed to ascertain question and answer sessions between student and lecturer despite having flexibility in learning.

Although internet connection was the major disadvantage for remote learning in this study, it is interesting to note that the participants were very resourceful in finding other options to ensure that learning continues on their end. The virtual presence of the lecturer as according to the findings of this study may have also played a crucial role in assisting the participants to transition from face-to-face interaction to remote learning.

CONCLUSION

Although 35.4% or the participants were satisfied with the current approach employed by their lecturer to teach mathematics remotely, there are still areas that need improvement to facilitate students' transition from face-to-face interaction to remote learning. A major drawback faced by the participants of this study was internet connection. The combination of synchronous and asynchronous learning may have assisted the participants' learning experience. Their preference towards lesson videos may also be due to internet connection issues. Hence, lecturers would need to improvise on the learning resources they provide students in order to assist the learning of mathematics remotely. Although this study does not generalise to the whole population of higher education students, the significance of this findings emphasises the dire need of internet providers and services to upgrade their bandwidth particularly in suburban and rural areas as remote learning is now a necessity in the education system.

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