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Undergraduates Students' Attitudes towards Fully Online Matmematics Learning at Universiti Kebangsaan Malaysia: A Staged Perspective

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Abstract

This study aims to identify the attitude levels of undergraduate students at Universiti Kebangsaan Malaysia towards fully online mathematics learning. A quantitative approach with a descriptive survey design was employed, involving 151 randomly selected students. A questionnaire was used to measure four main aspects of students' attitudes towards mathematics: value, enjoyment, self-confidence, and motivation. The findings revealed that students generally held a positive attitude towards online mathematics learning, with an overall mean score of 3.73. The value and enjoyment dimensions scored high, while self-confidence and motivation showed moderate levels. These results suggest that although students accept online learning, there is a need to improve their confidence and motivation to ensure effective and sustainable mathematics learning. The study recommends incorporating more interactive and supportive pedagogical approaches to maintain positive student attitudes and enhance academic achievement in mathematics.

Keywords: Student Attitude, Online Learning, Mathematics, Value, Self-Confidence, Motivation, Enjoyment

Introduction

In March 2020, the World Health Organization (WHO) declared that the world was facing the Covid-19 pandemic, including Malaysia. The number of Covid-19 infections in Malaysia is increasing every day. Therefore, the government decided to implement the Movement Control Order (MCO) under the Infectious Diseases Prevention and Control Act 1988 and the Police Act 1967 starting from March 18, 2020 (Ramli & Rahman, 2021) to break the chain of Covid-19 infection (Allam et al., 2020). Therefore, the Movement Control Order (MCO) was implemented to limit the movement and daily activities of the residents in Malaysia, including educational activities. Online mathematics learning has become a necessity throughout the Covid-19 pandemic, which has transformed the learning methods of students and lecturers

from traditional teaching methods to technology-based learning methods. Students' attitudes towards online mathematics learning are a critical factor in determining the success or failure of this educational technology.

Learning activities that used to take place in classrooms have become more flexible through online learning. The medium of online teaching and learning has shown remarkable changes in the development of higher education (Boz & Adnan, 2017). Among the changes that have occurred is that the tasks of students and lecturers have become increasingly challenging, especially in Mathematics courses, because this course requires an understanding of concepts, formulas, and problem-solving, which are quite difficult to implement online. However, its implementation has been improved over time with the availability of suitable technologies such as Edmodo, Google Classroom, Microsoft Teams, Zoom, and Google Meet, which can be used to enhance the effectiveness of online Mathematics learning. However, the effectiveness of online Mathematics learning is influenced by several factors. Among the factors that need to be given attention is the students' attitude towards online Mathematics learning. This attitude factor needs to be given attention because it will affect students' learning outcomes. (Mohd Fairuz et al., 2020).

The Frontiers study (2023) found that student's attitudes and perceptions towards Mathematics show a significant positive relationship. Important elements such as utility, confidence, and motivation in this subject are the main pillars in shaping students' perceptions of online learning. The Frontiers study (2023) also shows that although the perception of the usefulness of mathematics has increased, motivation towards this subject has decreased, indicating a complex relationship between various emotional and cognitive factors.

A systematic review published by Electronics (2023) outlines that the shift to online learning during the pandemic has changed students' perceptions overall. Although it has several advantages, such as flexibility and self-directed learning, there are still significant drawbacks, like social interaction and challenges in adapting to new technology. This experience proves that educational institutions must always be prepared with teaching and learning methods that can meet the current needs of digital learning.

Problem Statement

The sudden shift towards online learning that occurred following the COVID-19 pandemic has brought various new challenges to the teaching process and learning, especially in mathematics-based courses. This subject traditionally requires direct interaction between students and lecturers, as well as active involvement in problem-solving activities. The elements of direct interaction and collaboration are crucial in ensuring a deep understanding of abstract and complex mathematical concepts (Boz & Adnan, 2017). Although online learning offers various advantages such as time flexibility, opportunities for self-directed learning, and access to extensive digital materials (Bülow, 2022), various constraints also exist. Among them are the lack of meaningful social interaction, technological constraints such as weak internet connections, and difficulties in understanding content without sufficient visual and manipulative support (Denbel, 2023; Bringula et al., 2021).

Furthermore, recent studies show that student's attitudes towards online Mathematics learning are diverse and influenced by factors such as academic background, self-confidence levels, and perceptions of the effectiveness of digital pedagogy (Mihajlović et al., 2024). In this context, the use of online collaborative tools such as Google Docs or interactive platforms can have a positive impact on students' attitudes, but the outcomes depend on the support and learning design provided (Avci, 2012). Therefore, this study was conducted with the aim of deeply exploring students' attitudes towards online Mathematics learning and identifying the main challenges they face. The findings of the study are expected to contribute to the improvement of curriculum design and pedagogical approaches to support student achievement in the era of digital education.

Objective

Specifically, this study has one objective. The objective of this study is to examine the attitudes of undergraduate students towards fully online Mathematics learning.

Literature Review

Online mathematics learning has become increasingly important, especially since the Covid-19 pandemic. A study on students' attitudes towards online mathematics learning shows significant changes in the level of acceptance and effectiveness. Raes et al. (2019) state that hybrid learning, which combines online and face-to-face elements, can enhance student attendance and provide broader learning opportunities. However, a handful of students feel that they interact less with instructors and classmates, which somewhat affects their active participation in class (Bülow, 2022). This study shows that although online learning has its benefits, there are also several challenges in maintaining consistent student engagement in both hybrid and online learning environments.

The study by Arens et al. (2020) states that students' mathematical self-concept and academic self-efficacy play an important role in determining their attitudes towards online mathematics learning. Students with a positive mathematical self-concept tend to achieve better results in this subject and are highly likely to complete a degree program in mathematics. Furthermore, a study by Antonio and Tamban (2022) examined the effects of gamification on online mathematics learning. Although students showed a positive attitude towards mathematics after the use of gamification techniques, this study found that there was no significant difference in attitude between the group using gamification and the group using conventional teaching methods. However, there was a significant improvement in student performance in the group that used gamification. The study by Giovannella et al. (2021) proves that technology and remote learning have different impacts on students across the country. Students' attitudes towards technology and online learning are influenced by their respective national learning ecosystems, as well as several factors such as social interaction and technological support.

In conclusion, the level of students' attitudes towards online mathematics learning is influenced by various factors including mathematical self-concept, academic self-efficacy, teaching techniques such as gamification, as well as support and interaction within the learning ecosystem. Although there are challenges, studies show that with the right approach and support, online mathematics learning can achieve high effectiveness.

Theoretical Framework

The theory used to conduct this study is the Tripartite Model of Attitudes developed by Milton Rosenberg (Rosenberg et al., 1960), and it is used to describe attitudes towards Mathematics among students. This theory states that attitude consists of affective, behavioural, and cognitive components.

Tripartite Model of Attitudes

These three components focus specifically on students' attitudes towards Mathematics. Figure 1 illustrates a useful way to conceptualize the attitude components. The affective component refers to feelings related to the attitude. The behavioural component, on the other hand, refers to past and future behaviours related to the attitude. Then, the cognitive component refers to beliefs about attributes related to attitudes.

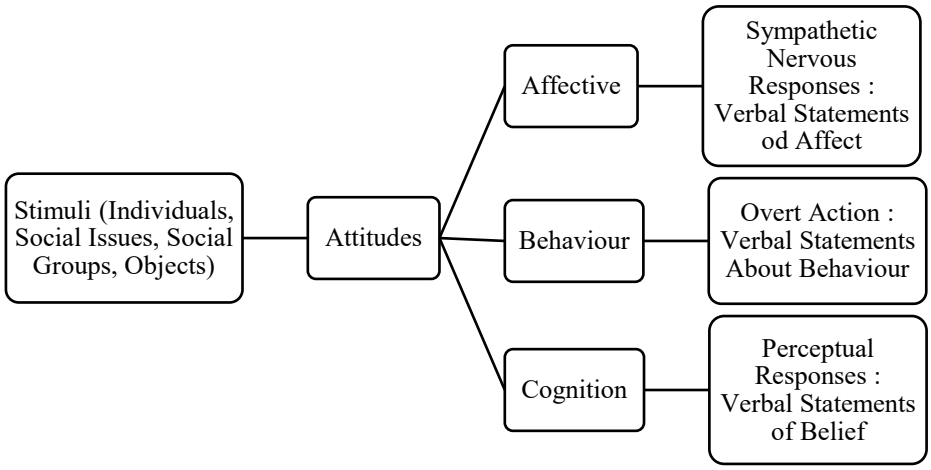

Figure 1. Tripartite Model of Attitudes
(Source: Rosenberg et al., 1960)

These components are closely interconnected and contribute to the overall attitude of students (Rosenberg et al., 1960). In this study, the components of attitude are viewed as a multidimensional construct in cognitive and affective aspects that provide a better understanding (Hannula, 2002, as cited by Can et al., 2017; McLeod, 1992)

Methodology

Design Study

According to Creswell (2009), the design of a study is a procedure and plan for conducting research that encompasses the study results from broad assumptions to detailed analysis and data collection techniques. According to Creswell (2005), the survey study design is a procedure in quantitative and qualitative research where the researcher conducts a survey on a sample or the entire population. Therefore, a descriptive survey study design is the appropriate research design to be used in this study to examine students' attitudes towards fully online Mathematics learning.

Sample Study

This study uses a quantitative approach with a descriptive survey design (Creswell, 2014). The study sample consisted of 151 students selected using the simple random sampling method. Data were collected through an online questionnaire and analyzed using descriptive statistics

with SPSS version 29 software. The questionnaire consists of four main constructs, namely values, enjoyment, self-confidence, and motivation.

Instrument Study

The use of questionnaires is widely employed in social science and education research because the data obtained from the study subjects can explain and generalize the research results to the study population (Creswell, 2012). Therefore, this study uses a questionnaire as the research instrument. The questionnaire was distributed online through two platforms, namely via student email and the WhatsApp application. This questionnaire was constructed by the researcher based on four aspects of the student attitude construct towards Mathematics by Tapia (1996). The questionnaire for this study consists of 2 parts: part 1 includes the demographic characteristics of the students, and part 2 contains 32 items from the Attitude Toward Mathematics Inventory (ATMI). The total number of items in the questionnaire for this study is 32 items as shown in Table 1 below.

Table 1
Details of the Survey Instrument

Construct	Aspects	Item Code	Item Numbers
Student's Attitude	Values	V	8
	Enjoyment	E	8
	Self Confidence	SC	12
	Motivation	M	4

This research instrument uses a five-point Likert scale as the response option from the study participants to identify the level of students' attitudes towards online Mathematics learning. The 5-point Likert scale method facilitates researchers in identifying the participants' values towards the items in this research instrument. Table 2 below shows the 5-point Likert scale evaluation scores used in this research instrument.

Table 2. 5
Likert Scale Score

Statement	Score
Strongly Disagree	1
Disagree	2
Normal	3
Agree	4
Strongly Agree	5

Validity And Reliability

Validity and reliability are two different elements. Both elements are one of the levels of perfection in a study. Through both elements, the study conducted can be measured and trusted or is consistent and further strengthens the research findings (Marshall & Rossman, 2014). Meanwhile, Creswell (2014) and Merriam (2009) also state that the validity and reliability in a study refer to the accuracy and consistency of the findings when produced.

Validity

The instrument for this study is adapted from the study by Johnston, K.F. (2022). The research instrument used by Johnston, K.F. (2022) has undergone a validation process beforehand. However, through this study, the questionnaire was translated, and its face and content validity were tested. In this regard, the researcher consulted two experienced Malay language teachers with over 25 years of teaching experience. The validation process took 3 weeks. During that period, modifications for each item were made repeatedly to ensure that the translated items did not deviate from their original meaning. The determination of the survey format structure is set according to Pallant's 2010 format, where each item must be comprehensive in terms of instructions, clarity of meaning, and the issues of the constructed items.

Reliability

Reliability refers to the consistency or stability of an instrument used (Ahmad Munawar et al. 2019). This means that an individual must obtain the same score consistently and without change, even when measured multiple times with the same instrument. Therefore, the researchers used the internal consistency method to determine the reliability coefficient by finding the Cronbach's Alpha value for each aspect and the overall instrument using the Statistical Package for Social Science (SPSS) software version 29. To ensure the reliability of this study instrument, a pilot study was conducted. This pilot study was conducted to observe the stability of the obtained Cronbach's Alpha value. The reliability coefficient value for this pilot study has been analysed and compared based on the Reliability Value Table (Lim, 2007) (refer to Table 3).

Table 3
Reliability Value

Reliability Coefficient	Numbers of Study Participants
More than 0.90	Very Good
0.80-0.89	Good
0.60-0.79	Medium
0.40-0.59	Doubtful
0.00-0.39	Rejected

Preliminary Study

Before conducting this study, the researcher conducted a preliminary study involving 33 Bachelor of Mathematics students at UKM to identify the reliability level of this research instrument and to determine the time taken by a student to answer the provided questionnaire. The reliability level of this instrument was tested based on the Cronbach's Alpha reliability value.

Table 4
Reliability Analysis of Instruments for Preliminary Study

Construct	Aspects	Item Numbers	Value of *Cronbach's Alpha*	Interpretation
Students Attitude	Values	8	0.92	Very Good
	Enjoyment	8	0.78	Medium
	Self Confidence	12	0.92	Medium
	Motivation	4	0.64	Medium
Overall Value of *Cronbach's Alpha* Instrument			**0.93**	**Very Good**

Table 4 presents the Cronbach's Alpha values for each construct of the research instrument. Referring to Table 3.4 above, it was found that the Cronbach's Alpha values for this research instrument range from 0.64 to 0.92. The highest Cronbach's Alpha value is 0.92 for the aspect of self-confidence and students' values towards online mathematics learning, while the lowest Cronbach's Alpha value is 0.64 for the aspect of students' motivation towards online mathematics learning. Overall, the analysis results show that the Cronbach's Alpha value for this study instrument is 0.925. Referring to the Reliability Value Table (Lim, 2007), the overall Cronbach's Alpha value for this research instrument is at a very good level, which proves that this research instrument has a very high reliability value.

Methods of Data Collection and Analysis

The data collection method for this study was conducted systematically to facilitate the feedback from the study respondents. The questionnaire instrument for this study uses the *Jotform* platform or application and was distributed in bulk through two online platforms, namely the WhatsApp application and the official email of UKM undergraduate students. The data collection process took two weeks. After collecting the data, the data was filtered and analysed using descriptive statistical methods through the Statistical Package for Social Science (SPSS) software version 29. The researcher analysed the data descriptively by referring to the mean and standard deviation values to address the objectives of this study.

Research Findings

Demographics of Study Participants

This study involved 151 participants consisting of Bachelor of Mathematics students at UKM. This study involved 48 male students and 103 female students. Table 5 below shows the demographics of the study participants in terms of their age and the status of students' experience in fully online Mathematics lectures.

Table 5
Demographics of Study Participants Category

Category		Number of Study Participants
Age	18 – 20 years old	138
	21 – 23 years old	5
	24 – 26 years old	8
	27 years and older	0
Experiences attending Mathematics lectures entirely online	Yes	98
	No	53

Based on Table 5, most of the study participants are students aged between 18 and 20 years, with a total of 138 participants. Only a small number of participants fall within the age ranges of 21 to 23 years and 24 to 26 years, with 5 and 8 participants respectively. Meanwhile, there were no study participants aged over 26 years who took part in this study. Table 5 above also shows that most of the study participants have experience taking Mathematics courses entirely online, with a total of 98 participants, while 53 participants in this study do not have experience taking Mathematics courses entirely online.

The Level of Students' Attitude towards Online Mathematics Learning
The objective of this study is to identify the level of students' attitudes towards online Mathematics learning. The level of students' attitudes towards online learning was analyzed using descriptive analysis by looking at the mean score level according to Neuman's (2012) perspective (see Table 6).

Table 6
Interpretation of Mean Scores on a 5-Point Likert Scale

Mean	Mean Level
1.00 – 2.39	Low
2.40 – 3.70	Medium
3.71 – 5.00	High

Source: Neuman (2012)

Table 7
Descriptive Analysis for each item of Students Attitude towards Mathematic

Item Code	Statement	Mean	Standard Deviation	Mean Level
VM1	I aspire to improve my proficiency in the field of Mathematics.	4.79	0.405	High
VM2	Mathematics plays an important role in the intellectual development of individuals and teaches someone to apply critical thinking.	4.81	0.412	High
VM3	Mathematics plays an important role in daily life.	4.60	0.555	High
VM4	Mathematics is an important subject to be learn	4.68	0.511	High
VM5	I can consider various ways to apply Mathematics outside the classroom.	4.28	0.723	High
VM6	I think that studying an Advanced Mathematics course is very useful.	4.39	0.721	High
VM7	I am confident and believe that studying Mathematics can help me solve problems.	4.59	0.569	High
VM8	Strong mathematics can help with the development of my career.	4.61	0.553	High
EM1	I like studying Mathematics	4.50	0.662	High
EM2	I like solving math problems.	4.44	0.669	High
EM3	I am more inclined to do assignments in the field of Mathematics rather than writing essays.	4.54	0.772	High
EM4	I like Mathematics	4.53	0.671	High
EM5	Mathematics is a very interesting subject	4.57	0.658	High
EM6	I am comfortable expressing my views on strategies for finding solutions to mathematical problems.	4.21	0.780	High
EM7	I am comfortable answering question in Mathematics lecture	3.83	0.958	High
EM8	Math is boring and uninteresting	1.89	1.161	Low
SC1	When I hear the word Mathematics, a feeling of dislike arises.	1.88	1.160	Low
SC2	My mind goes blank, and I have difficulty thinking clearly when it comes to Mathematics.	2.25	0.864	Low
SC3	Studying Mathematics will make me feel nervous	2.23	1.197	Low
SC4	Mathematics causes me discomfort.	1.93	1.102	Low
SC5	I always feel anxious when considering math problems.	2.17	1.159	Low
SC6	I am always confused and have difficulty understanding Math lectures.	2.52	1.124	Medium
SC7	I feel insecure when answering Math questions.	2.08	1.134	Low
SC8	Math has never scared me.	3.40	1.103	Medium
SC9	I can solve Math problems without feeling difficult.	3.15	1.035	Medium
SC10	I expect success in the entire Mathematics course taken	3.97	0.852	Low
SC11	I learn Mathematics easily.	3.48	0.915	Medium
SC12	I believe that I am smart in solving Math problems.	3.57	0.956	Medium
M1	I plan to study Mathematics as much as possible throughout my studies.	4.07	0.865	High
M2	The Math Challenge has caught my attention.	4.07	0.806	High
M3	I am willing to study Mathematics more than the required amount.	3.66	0.945	Medium
M4	I want to avoid teaching the Mathematics course.	2.31	1.218	Low

Table 8
Descriptive Analysis for all item according to the aspects

Item Code	Aspects	Item Numbers	Mean	Standard Deviation	Mean Level
VM	Values towards Mathematics	8	4.60	0.40	High
EM	Enjoyment towards Mathematics	8	4.06	0.51	High
SC	Self Confidence towards Mathematics	12	2.72	0.64	Medium
M	Motivation towards Mathematics	4	3.53	0.62	Medium
		Total	3.73	0.40	Low

Table 7 above presents the results of the descriptive analysis for each item in the section on students' attitudes towards online mathematics learning, while Table 8 refers to the results of the descriptive analysis for all items according to their respective aspects. Attitudes towards learning Mathematics are viewed through 4 aspects. These aspects are in terms of students' values towards Mathematics, students' enjoyment of Mathematics, students' self-confidence in Mathematics, and the aspect of students' motivation towards Mathematics. Referring to Table 7, for the aspect of students' value towards Mathematics, item VM2 has the highest mean score with a mean score of 4.81 and a standard deviation of 0.412, while item VM5 has a lower mean score with a mean score of 4.28 and a standard deviation of 0.723 compared to other items in the aspect of students' value towards Mathematics. However, the overall items for the aspect of students' value towards Mathematics have a high mean score with a mean score of 4.60 and a standard deviation of 0.40 (refer to Table 8).

For the aspect of students' enjoyment of Mathematics, based on Table 7, item EM5 has the highest mean score with a mean of 4.57 and a standard deviation of 0.658, while item EM8 has the lowest mean score with a mean of 1.89 and a standard deviation of 1.161 among all other EM items. However, the overall item for the aspect of students' enjoyment of Mathematics was found to have a high mean score with a mean of 4.06 and a standard deviation of 0.51 (refer to Table 8).

In the aspect of students' self-confidence in Mathematics, referring to Table 7, the item with the highest mean score is item SC10 with a mean score of 3.97 and a standard deviation of 0.852. Meanwhile, item SC1 was found to have the lowest mean score with a mean score of 1.88 and a standard deviation of 1.160. However, based on Table 8, the overall items for the aspect of students' self-confidence in Mathematics have a moderate mean score of 2.72 and a standard deviation of 0.64.

The last aspect, which is the aspect of students' motivation towards Mathematics, is also seen to have a moderate mean score with a mean score of 3.53 and a standard deviation of 0.62 (refer to Table 8). However, based on Table 7, those two items M1 and M2 in this aspect have a high mean score with the same mean score of 4.07 and a standard deviation of each item is 0.865 and 0.806 respectively.

Based on Table 7 above, overall, item VM2 for the aspect of students' values towards Mathematics has the highest mean score with a mean score of 4.81 and a standard deviation of 0.412, while item for the aspect of students' self-confidence in Mathematics has the lowest mean score with a mean score of 1.88 and a standard deviation of 1.160. Overall, all items regarding students' attitudes towards Mathematics have a high mean score of 3.73 with a standard deviation of 0.40 (refer to Table 8).

Discussion

The Level of Students' Attitude Towards Online Mathematics Learning

Overall, the study findings indicate that the level of students' attitudes towards online Mathematics learning is at a high level. Proven through the overall mean score recorded, which is 3.73, falling into the high category based on the Likert scale used. Analysis of the 32 survey items shows a mean score range between 1.88 (low) and 4.81 (high), reflecting the diversity of students' perceptions regarding certain aspects of online Mathematics learning. These findings directly indicate that UKM students generally have a positive attitude towards this learning approach. More specifically, students' attitudes towards online Mathematics learning encompass several key dimensions, including interest in the subject, level of self-motivation, anxiety towards Mathematics, and level of self-confidence. Most students show a high interest in the use of technology in Mathematics learning because it provides flexibility and freedom to access learning materials at their own time and comfort. The level of motivation was also found to be high among students who enjoyed solving Mathematics problems in an interactive digital environment. However, there are still several students who experience anxiety regarding their understanding of complex Mathematical concepts, especially when interaction with lecturers is limited. However, most students show a high level of confidence in their ability to learn and master this subject even online, supported by their ability to manage time and through good resources.

Then, the highest attitude aspect among students is "value towards Mathematics," with a mean score reaching 4.60. These findings indicate that students consider Mathematics as an important and useful subject in their daily lives and future. This attitude indicates a high level of awareness among students regarding the role of Mathematics in careers, logical thinking, and problem-solving. These findings align with the study by Dowker and Sheridan (2022), which states that students with a positive attitude towards Mathematics tend to show better academic achievement, while a negative attitude can affect students' motivation and performance in this subject. This is consistent with the findings of Khaiwal and Gupta (2025), which demonstrated a significant positive relationship between students' attitudes towards Mathematics and their academic achievement, with students who have a very positive attitude showing higher test scores.

Next, the aspect of students' enjoyment of Mathematics also showed a high mean score of 4.06, indicating that a large majority of students have a positive perception and enjoy participating in online Mathematics learning. Enjoyment of the subject not only affects students' interest but also influences their level of active engagement in class, whether through interaction, participation in problem-solving activities, or continuous efforts to understand complex concepts. These findings are supported by the study of Pekrun et al. (2011), which emphasizes that students who experience enjoyment in learning Mathematics are more likely to show high levels of motivation, active engagement in learning activities,

and better academic achievement compared to students who experience negative emotions such as boredom or anxiety. Their study within the context of academic emotion theory also shows that enjoyment is a positive emotional element that acts as a catalyst for overall learning success. In the context of online learning, students' enjoyment of Mathematics is also influenced using interactive and user-friendly technology, which can enhance students' interest and engagement. As demonstrated in the study by Avci (2012), the use of online communication tools creatively has successfully improved students' positive perception of this subject and made learning more enjoyable.

Overall, the combination of positive attitudes, interest, values, and enjoyment towards Mathematics in a digital environment indicates that online learning has the potential to continue supporting students' cognitive and emotional development if implemented with appropriate strategies. Therefore, the provision of interactive, relevant, and student-friendly pedagogical approaches should be prioritized so that this positive attitude can be maintained and enhanced over time.

Conclusion

This study aims to assess the attitude of Bachelor of Arts students at Universiti Kebangsaan Malaysia (UKM) towards fully online Mathematics learning. In the context of the sudden changes due to the COVID-19 pandemic, online learning has become the new norm in the education system, including for critical subjects like Mathematics. Through a quantitative approach with a descriptive survey design involving 151 students, the findings indicate that overall, students have a positive attitude towards online Mathematics learning, as evidenced by a high overall mean score (3.73). The four main attitude aspects studied are value, enjoyment, self-confidence, and motivation towards Mathematics. The aspects of value and enjoyment recorded a high mean level, indicating that students recognize the importance of this subject and enjoy following it. However, the aspects of self-confidence and motivation show moderate levels, indicating the need for deeper interventions to enhance students' belief in their abilities and to stimulate motivation in the digital learning environment. The study also discusses that students' attitudes are influenced by various factors such as previous learning experiences, technological support, pedagogical design, and the available learning ecosystem. The literature review supports these findings by emphasizing the role of psychosocial and technical elements in shaping students' attitudes, as well as the effectiveness of approaches such as gamification, hybrid learning, and the use of interactive platforms. In conclusion, online Mathematics learning has high potential for success if supported by interactive pedagogical strategies, robust technological support, and appropriate psychological interventions. Therefore, the provision of a learning approach that is comprehensive and student-centered approaches are important in ensuring that students' positive attitudes towards online Mathematics can be enhanced and maintained.

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