Mathematics Performance Among Pre-Diploma Students with Online Learning Approach During Movement Control Order (MCO)

Jamal Othman[1], Nurhafizah Ahmad[1], Norazah Umar[1], Rozita Kadar[1], Syarifah Adilah Mohamed Yusoff[1], Naemah Abdul Wahab[1], Mohd Norazmi Nordin[2]

[1]Jabatan Sains Komputer & Matematik (JSKM),
Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia
[2]Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Email: jamalothman@uitm.edu.my , nurha9129@uitm.edu.my , norazah191@uitm.edu.my , rozita231@uitm.edu.my , syarifah.adilah@uitm.edu.my , naema586@uitm.edu.my , KOSONG

Abstract

Various teaching and learning approaches have been applied among educators to the students during the Movement and Control Orders (MCO) employed due to COVID-19. Educators especially those who are teaching the mathematics subject require comprehensive and effective tools to help their students understand the concept and able to do exercises with less face-to-face guidance or a normal conventional teaching approach. Teaching the mathematics subject especially to the Pre-Diploma students is very challenging as they are quite weak in mathematics fundamentals and coincidentally, they have to face the obstacles of teaching approach with Online learning during MCO. Hence, a mathematics teaching model with an online learning approach was created to make the teaching delivery effective, thus increasing the learning curve or performance of mathematics among students. The ongoing and final assessment results of the students were analysed using an independent sample t-test to measure the difference between those experiencing and without experiencing the suggested model.

Keywords: performance, pre-diploma, mathematics, online learning, MCO

Introduction

The pandemic COVID-19 virus has changed the world activities to the new norms in all sectors including the Malaysian education sector. Schools and universities have been instructed to be closed for controlling the COVID-19 transmission. Due to campus closures, all academic institutions turned to an online system to continue the teaching and learning process (Lalani 2020). Although some of the businesses were opened after Movement Control Orders (MCO), the education sector remained closed (Pui 2020).

A similar situation is also affecting the pre-diploma students specifically the pre-commerce students at Universiti Teknologi MARA. Most of the students came from low-income families and are in need of sponsorships or special funds from university (UiTM 2020). In addition, students with average results especially in Mathematics and English according to

their SPM (the Malaysian Certificate of Education) result were given the chance to pursue their ambition to continue their studies at university. Since the online learning approach needs to be implemented to continue the teaching and learning process during MCO, it becomes so cumbersome and stressful to the educators to ensure an effective teaching process that is satisfactorily delivered especially in teaching Mathematics to weak students.

Therefore, comprehensive teaching and learning (T&L) model was proposed by the educators for the pre-commerce program students specifically for Mathematics during the Academic Semester October 2020 – February 2021. This paper shares innovative ideas and external factors that influence the performance of Mathematics subject using the online learning approach during the MCO. The students' results of ongoing and final assessments were used to measure the performance and conclude the effectiveness of methods used for teaching the mathematics subject.

The organisation of this paper continued with the discussion of related research or literature review. The methodology in developing a model that applied for teaching mathematics for pre-diploma programme students is explained in more detail. The following section presents the analysis and discussion of the results on the student performance to measure the effectiveness of the suggested model for teaching Mathematics subject to pre-commerce program students. Finally, the conclusion includes future improvement and recommendations to improvise the proposed model.

Literature Review

Students' academic performance is the ultimate focus at any education institutions either primary, secondary or tertiary level (Mohammad et al. 2020). Various studies have been conducted to determine the factors influencing student performance regardless of any subjects. Based on previous studies, found that there is no relationship between gender and students' performance (Ismail & Kasim 2011; Papageorgiou & Halabi 2014; Kukreja & Habib 2013; Prochazka 2016). A similar study that focused on the student's interest in the subject shows that students who have an interest in a subject performed better compared to those who are not interest (Singh et al. 2002).

The students' performance during MCO is closely related to internet accessibility and it is the main issue that has been discussed. The education sector does not guarantee that all students are able to get unlimited internet access and stable interconnectivity. According to a report, 70% of internet users are from urban areas (Pui 2020). Studies have also shown that there is unequal access to the internet and the power of buying computer gadget during MCO between the students from high-income and low-income families (Jæger & Blaabæk 2020). Hence, the internet speed, signal coverage and computer gadget purchasing depend on their budget and locality. The affected students may feel unfair and less privileged if the classes or assessment are fully conducted through an online platform.

The student performance is also affected whenever the class is abruptly changed using an online learning approach. Based on a survey, 42% of students did not agree or shown no interest at all the classes conducted in online basis during the MCO (QS 2020). The main

problem is that students were dissatisfied with the home environment as the platform to study since there are a lot of interruptions and responsibilities. Furthermore, students need to familiarise themselves with the new norms of communication platforms and teaching tools, as well as pedagogical of online learning approach. This scenario different from the conventional face-to-face methods whereby in the online classes, students need to compromise with quality of internet intermittent problems or network performance (Arumugam 2020). Nevertheless, when the paradigm shifted to online learning, educators need to work hard to familiarise the new norms of teaching pedagogical by learning new communication tools such as Zoom, Google Meet and Microsoft Teams to make sure that the class continues as usual (Lau et. All 2020). Therefore, educators need to be exposed and explore more relevant technology and various digital resources to make the mathematics class fun.

One of the online learning approaches is the blended learning. Blended learning represents the integration of multiple tools such as emails, video streaming, forum, and documents sharing combined with conventional methods of teaching (Willet 2002). According to previous research, there was significant progress in student performance when the traditional teaching method was combined with computer-assisted teaching that implemented in the blended learning (Dalton & Hannafin 1988). The research shown a positive result in students' performance whenever the computer-assisted teaching method was partially incorporated with the traditional teaching method, hence changing the teaching method from teacher-centred to student-centred approach. The blended learning encouraged interactive activities such as group discussion, create collaborative and innovative ideas as active learners. Consequently, students' opinions can be easily collected or shared among the group members.

The attitude of the student is also a contributing factor to the performance in Mathematics. Mathematics attitude can be defined as an indication of personal ideology, perspective and mathematics practices in daily life (Tan 1992). The perspectives of mathematics attitude can be divided into six (6) dimensions namely (a) confidence of learning mathematics, (b) expectation to success, (c) practicality in their daily life, (d) effort to explore, (e) anxiety to learn and (f) perception of teacher or parent on student's performance (Fennema & Sherman 1967).

Mathematics can develop the students' intellectual and technical competencies, promote dynamic creativity, improve self-esteem and encourage entrepreneurship (Titilope 2017). The model of MCIEC (Motivation, Context, Interactivity, Evaluation and Connectivity) encourages student involvement in mathematics assessment (Ahn & Edwin 2018). This model will enhance the student effort or ability to understand the contents, increase interest and motivate them to learn mathematics. Therefore, the integration of this model with e-learning and blended learning would improve the aspects related to student assessment, self-motivation and their interest in mathematics. This would further promote a more meaningful learning environment and assessment given that the students are adaptable to their needs (Albano & Dello 2019).

Methodology

As mentioned earlier, the purpose of this study is to measure the performance of the pre-commerce students of the pre-diploma program during MCO at the UiTM Pulau Pinang branch. The students have been put through the class for one semester starting October 2020 until February 2021. Before the final assessment for the mathematics subject is given in the end of semester, which is in the early of February 2021, the students have been exposed to various tools and teaching approaches to enhance the learning curve effectiveness. In addition, the students have been given a short briefing and training on the teaching platform for the online classes during the orientation week.

Furthermore, specifically for mathematics subject, the students have been explained by the respective lecturer on how the class will be conducted through an online learning platform. During the briefing session, several issues have been raised by the students specifically on internet access and financial problem. The students were advised to stay in the campus if they do not have internet facilities in their respective residences or the signal receiver is very weak. Meanwhile, for those who come from a low-income family and do not have any devices to aid their learning process such as laptop or smartphone, the university will help and equip them with special funds. The students were also being funded with special allowances which they can use to buy computer gadgets for class purposes. These incentives will promote the students' motivation to pursue their ambition to study at university and catalyse their interest in the mathematics subject. The incentive is an inducement or supplemental reward that serve as a motivation for learning purposes (Grove & Hadsell 2012).

In Figure 1, depicted a proposed model that was applied to the students of the pre-commerce program at the UiTM Pulau Pinang branch specifically for the subject of mathematics. The aim of this model is to create interest among students and improve student performance in mathematics.

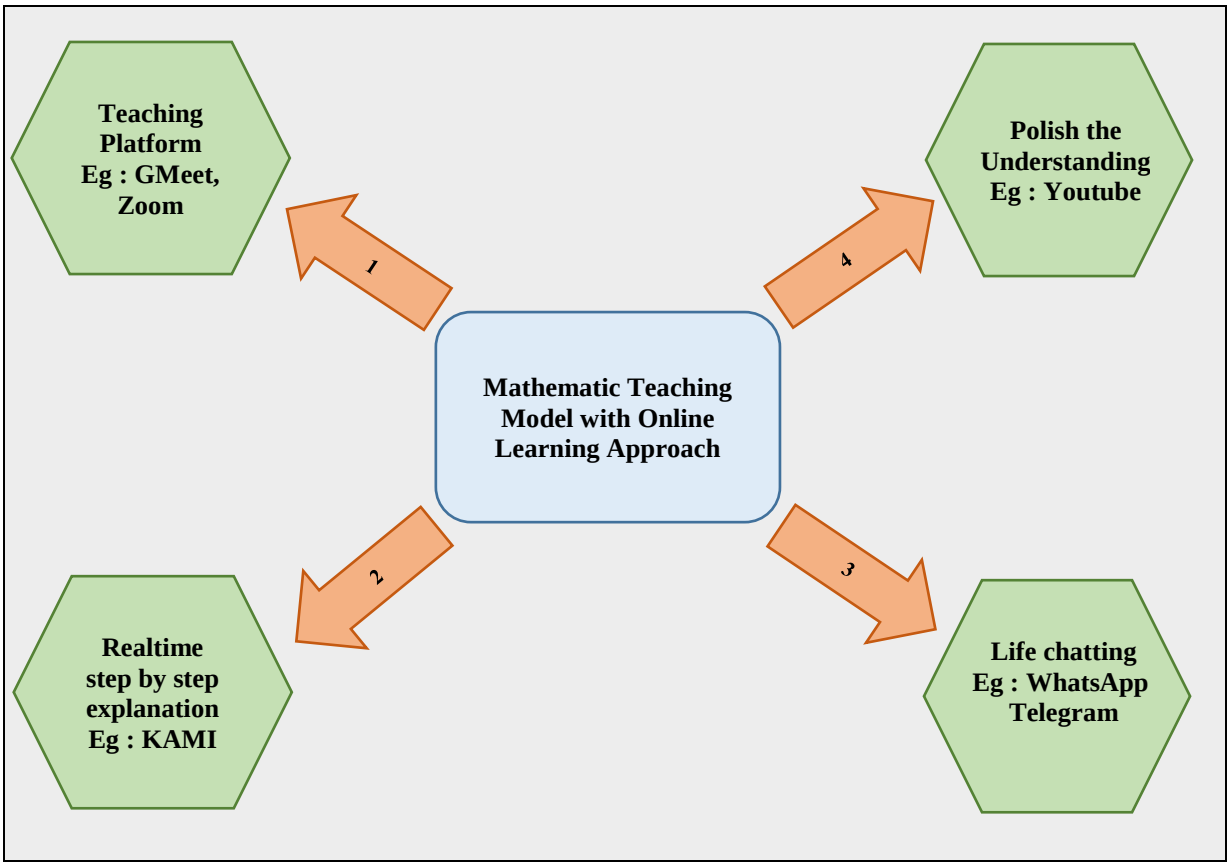

Figure 1: Mathematics Teaching Model with Online learning Approach

for Pre-Commerce Programme

The figure shows four (4) main components that need to be considered for the effectiveness of online learning classes especially for teaching mathematics. Since conventional or face-to-face classes are not allowed, online platforms such as Google Meet or Zoom applications were used. These applications allowed the instructors to give a lecture up to 100 students in one session. Instructors can share whatever they see on their computer with students by sharing their entire computer screen and live lectures can be recorded and viewed for revision purposes. The following figure (in Figure 2) shows the class that was conducted using the Google Meet platform with 25 students joining the session.

Figure 2: The class conducted with Google Meet Platform.

The second component that needs to be enforced by the lecturer is that the explanation to students needs to be in real-time. The lecturer cannot use or just rely on the PowerPoint presentation while teaching mathematics on weaker students. Detailed explanation helps students to understand the topic. KAMI is the online application that enables the instructors to show the detailed steps of mathematics calculation online, which is similar to that written on a whiteboard in the classroom as shown in Figure 3. In addition, the students can record the lecturer's explanations on Google Meet and watch back the video to understand the step as explained using KAMI.

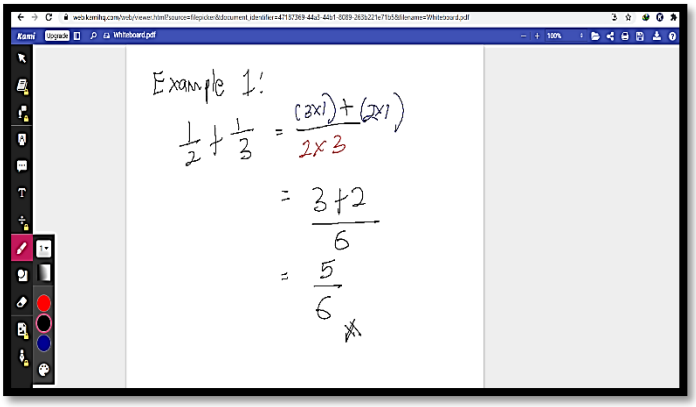

Figure 3: Explanation using KAMI

The third component is basically for personal coaching or consultation through the WhatsApp application. Direct chatting through WhatsApp or Telegram is quite effective to tighten their understanding of the topic taught during an online class. Some students are quite shy to ask questions during an online class. Thus, they can use this platform to ask the questions and normally, the consultation period will be long until the students are satisfied with the explanation or tending to ask the lecturer to check extra exercises from past years' questions.

The fourth component is the extra self-study from watching the video through YouTube to polish their understanding and skills on the topic. The students can repeat the video, which helps them to remember and improve their understanding of the topic.

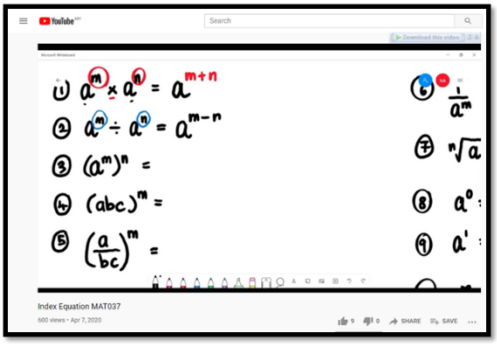

Figure 4: Improve Understanding through YouTube

These four components have been practised by all students who enrolled in the mathematics subject and most of them felt like they are attending the face-to-face class. Although there were some challenges or obstacles, they were resolved once everybody in the online class actively participate, help each other and give positive cooperation.

To determine the effectiveness of the model, the students' results of ongoing and final assessments were taken from four (4) different classes. The average number of students in each class is approximately 25 students. Generally, the data collection involved two groups of students; one group that has gone through or experienced the suggested Mathematics Teaching Model for one semester of the academic session and another group that had never experienced or practised the suggested model. The following section discusses the analysis and results to conclude the effectiveness of the model for teaching mathematics.

Data Analysis

This research used the data of scores among two groups of students (the classes that practised the Mathematics Teaching Model and those without the model) that were put through Assessment 1, Assessment 2, Assessment 3 and Final Assessment. Table 1 shows the type of assessment for the mathematic subject.

Table 1: Assessment Type for Mathematic

Assessment Number	Assessment Type
Assessment 1	Quiz
Assessment 2	Test
Assessment 3	Test
Assessment 4	Final Assessment

The data were analysed using an independent sample t-test. In terms of the objective of the present study, which is to measure the effectiveness of the model suggested for teaching mathematics subject for pre-commerce program students, the independent sample t-test was used to examine the differences in mean assessment score between the classes who experienced the Mathematics Teaching Model and without the model. This parametric test compares the means of two independent groups to identify whether there is statistical evidence that the associated population means are significantly different. The independent samples t-test requires the assumption of homogeneity of variance, which means that both groups have the same variance.

The use of Statistical Package for Social Sciences (SPSS) conveniently included a test for the homogeneity of variance called the Levene's test to show that an independent sample T-test was run. The null hypothesis for Levene's test was the population variances of group 1 and 2 are equal. This implies that if Levene's Test's null hypothesis is rejected, the variances between the two groups are not equal, which indicates that the assumption of variance

homogeneity is violated. The alternatives hypotheses for the independent t-test can be expressed as:

H_{11}: There is a significant difference in the mean score of Assessment 1 between the classes that experienced the Mathematics Teaching Model and those without the model.

H_{12}: There is a significant difference in the mean score of Assessment 2 between the classes that experienced the Mathematics Teaching Model with the online learning approach and those without the model.

H_{13}: There is a significant difference in the mean score of Assessment 3 between the classes that experienced the Mathematics Teaching Model with Online learning Approach and those without the model.

H_{14}: There is a significant difference in the mean score of Final Assessment between the classes that experienced the Mathematics Teaching Model with online learning approach and those without the model.

Result and Discussion

A total of 146 responses were collected from Pre-Diploma students who enrolled for the MAT037 course. Table 2 shows that 59 (40.4%) responses were male and 87 (59.6%) were female. The respondents were equally divided into two categories: 1) not practising the Mathematic Teaching Model with online learning approach 2) experiencing the Mathematic Teaching Model with online learning approach. In Group 1, 27 of the respondents were males while 46 were females, followed by 32 males and 41 females for Group 2.

Table 2: Cross Section between Method and Gender

		Gender		**Total**
		Male	Female	
Method	Not practice	27	46	73 (50%)
	Experiencing	32	41	73 (50%)
Total		59 (40.4%)	87 (59.6%)	146

Table 3: Mean and Standard Deviation for Assessments

	Mean	**Standard Deviation**
Assessment 1	22.70 (75.67%)	4.92
Assessment 2	38.67 (77.34%)	8.55
Assessment 3	28.55 (71.38%)	7.89
Final Assessment	47.04 (78.4%)	10.34

Table 3 indicates that the mean for Assessment 1, Assessment 2, Assessment 3 and Final Assessment were 22.70, 38.67, 28.55, and 47.04, respectively, with a standard deviation of

4.92, 8.55, 7.89 and 10.34. The total marks for each assessment were 30, 50, 40, and 60, respectively; therefore, the percentage of the mean for Final Assessment was the highest (78.4%) among all four assessments followed by Assessment 2 (77.34%), Assessment 1 (75.67%) and Assessment 3 (71.38%).

Table 4: Mean vs Method

	Method	**Mean**	**Std Deviation**
Assessment 1	Not practising	21.99	5.38
	Experiencing	23.42	4.32
Assessment 2	Not practising	36.67	9.49
	Experiencing	40.66	6.99
Assessment 3	Not practising	25.27	8.08
	Experiencing	31.82	6.18
Final Assessment	Not practising	44.45	12.46
	Experiencing	49.63	6.82

Mean according to the category of method was calculated for further analysis. From Table 4, the mean values of Assessment 1, Assessment 2, Assessment 3 and Final for students who did not practise the model were found to be 21.99, 36.67, 25.27, and 44.45, respectively, with 5.38, 9.49, 8.08 and 12.46 standard deviations. For the group that experienced the model, the mean values of Assessment 1, Assessment 2, Assessment 3 and Final were found to be 23.42, 40.66, 31.82, and 49.63, respectively, with standard deviations of 4.32, 6.99, 6.18, and 6.82.

Table 5: Levene's Test and t-test output

	Levene's Test for Equality of Variances			**t-test for Equality of Means**		
		F-test	p-value	t-test	degree of freedom	p-value
Assessment 1	Equal variances assumed	2.672	0.104	-1.762	144	0.080
	Equal variances not assumed			-1.762	137.649	0.080
Assessment 2	Equal variances assumed	9.218	0.003	-2.893	144	0.004
	Equal variances not assumed			-2.893	132.324	0.004
Assessment 3	Equal variances	8.054	0.005	-	144	0.000

	assumed			5.500	134.775	0.000
	Equal variances not assumed			-5.500		
Final Assessment	Equal variances assumed	18.587	0.000	-3.121	144	0.002
	Equal variances not assumed			-3.121	111.665	0.002

Table 6: Summary result for the hypothesis in the study

No	Alternative Hypotheses Statement (H_1)	Result
1	There is a significant difference in the mean score of Assessment 1 between the classes that experienced the Mathematics Teaching Model and those without the model.	Not supported
2	There is a significant difference in the mean score of Assessment 2 between the classes that experienced the Mathematics Teaching Model with online learning approach and those without the model.	Supported
3	There is a significant difference in the mean score of Assessment 3 between the classes that experienced the Mathematics Teaching Model with online learning approach and those without the model.	Supported
4	There is a significant difference in the mean score of Final Assessment between the classes that experienced the Mathematics Teaching Model with online learning approach and those without the model.	Supported

In this study, four methods based on Mathematic Teaching Model with Online learning Approach were implemented in a 14-week-long of academic session. Table 5 above shows that the t-test assumes that the variances are approximately equal in two groups. Based on the results, it showed that there was no significant difference in mean assessment 1 score (t-test=-1.762, p-value>0.05) between the students in classes that experienced the Mathematics Teaching Model and those without the model. The results indicated that both groups of students performed at the same level for Assessment 1. This is consistent with Julio César Bahamón and Audrey Rorrer (2020) findings. They investigated learning outcomes within an undergraduate C Programming course taught in multiple modalities, including in-person, online, and blended learning. The Kruskal-Wallis H test, which was conducted on a subsample of 42 students from the propensity score-matched group, showed no statistically significant differences in course grade results between different modalities.

This is an expected finding due to the adaptation of the first semester students to the new learning method. Switching from face to face with the lecturer's guidance to computer-based education in a virtual classroom gives students a different learning experience. It takes some

time for them to get accustomed to the new methods. There must be some obstacles when students first use online tools such as computer literacy, environment and time management. Students who used computers for activities perceived that they could not adopt blended learning because of a lack of an enabling environment (Mswazi Tshabalala et al. 2014). For a pre-diploma student with an average result, this is a great challenge. After about a month following the online learning method, their result has improved constantly from Assessment 1 to the Final Assessment. This shows that this new method helped them to understand their lesson well.

In contrast, Table 5 showed a significant difference in the mean score of Assessment 2 (t-test=-2.893, p-value =0.004) between the students in classes who experienced the Mathematics Teaching Model and those without the model. This implies that the Mathematics Teaching Model was effective in improving students' academic performance during online learning. Comprehensive explanations helped the students as they gained a better understanding of the subject by seeing an example of the necessary steps and flow of the mathematics calculation using KAMI. Additionally, students used YouTube to enhance their understanding. The students repeatedly watched the video, which helped them remember and develop their understanding of the subject. These findings seemed to be directly supporting the hypothesis that the Mathematics Teaching Model would enhance the performance of the students.

This finding is in line with Mulenga and Marbán's (2020). The study examined prospective teachers' online learning mathematics activities in the age of COVID-19 pandemic. The researchers discovered a statistically significant mean difference between the magnitude of prospective teachers' online learning mathematics practices and the eight activities, but no statistically significant mean difference in the way students search the Internet for information to help them understand mathematics concepts better.

The results of this study revealed a substantial difference in mean of Assessment 3 scores (t-test=-5.500, p-value=0.000) between students in classes who experienced the Mathematics Teaching Model and those who did not. Based on the observations, more questions were posted using WhatsApp compared to the online class session. It is believed that the chat on WhatsApp allowed students to clarify their doubts clearly. Additionally, it was also delighted that students were also actively sharing their perspectives on the chat. They used this medium to ask questions, and the consultation period usually lasted longer until the students were pleased with the response.

Another important finding was a significant difference in mean scores of Final Assessment (t-test=-3.121, p-value=0.002) between the students in classes who experienced the Mathematics Teaching Model and those without the model. These findings appeared to support the hypothesis that the Mathematics Teaching Model could improve student performance. The use of Google Meet or Zoom as a teaching platform in class provided students and instructors with instantaneous feedback and an opportunity to address misunderstandings promptly. This medium was also used to encourage discussion among

students, which provided the opportunity for peer-to-peer learning, thus building their understanding of the subject.

Furthermore, the findings of the study are in accordance with the work of Onweh and Akpan (2014) that found a significant difference in academic performance of students in Electrical Installation taught using discussion and lecture approaches, demonstration and inquiry strategies. When comparing discussion to demonstration, lecture and inquiry strategies, students in the discussion class performed better than those in the lecture group, but less than students in demonstration and inquiry groups.

Conclusion

The online learning approach in teaching the mathematics subject is questionable since it has started to be implemented especially on the acceptance and effectiveness among students or instructors. The instructors need to create attractive module, platform, environment, courseware and teaching tools to make the online learning approach more effective and boost the confidence level among students and their parents. The transition from lecturer-centred to student-centred is the aim of national education policy for the students who can innovate creative ideas to produce future leaders, high demanded assets, work with minimal supervision or work independently and assimilate moral values to become excellent graduates.

The model of teaching mathematics to Pre-Commerce Programme students, as shown and discussed in this paper, can be further improvised by embedding additional components to enhance the online learning approach effectiveness. Sharing of online learning teaching approach experiences among educators from different institutions will innovate new creative ideas. Hence, it will encourage motivation and active learning among students without leaving nobody behind during the learning process.

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