INVESTIGATE STUDENTS' ACADEMIC ACHIEVEMENTS IN MATHEMATICS COURSE THROUGH E-LEARNING APPROACHES

Che Haziqah Che Hussin[1*], Nurliyana Juhan[2], Suriana Lasaraiya[3], Ayu Afiqah Nasrullah[4]

[1] Preparatory Centre for Science and Technology, Universiti Malaysia Sabah, Malaysia
   Email: haziqah@ums.edu.my
[2] Preparatory Centre for Science and Technology, Universiti Malaysia Sabah, Malaysia
   Email: liyana87@ums.edu.my
[3] Preparatory Centre for Science and Technology, Universiti Malaysia Sabah, Malaysia
   Email: suriana@ums.edu.my
[4] Preparatory Centre of Science and Technology, Universiti Malaysia Sabah, Malaysia
   Email: ayu.afiqah@ums.edu.my
* Corresponding Author

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Abstract:

This paper investigates students' academic achievements through e-learning approaches based on students' preference. E-learning approaches can be considered as asynchronous, synchronous and blended learning. Asynchronous learning happens when there is no set time for it to occur. Allows students to learn whenever and wherever they want, at their own pace. Web conferencing and chatting are used to deliver organised and time-bound activities characterise synchronous e-learning. Due to the Movement Control Order (MCO), which went into effect on March 18, 2020, lecturers at the Preparatory Centre for Science and Technology, Universiti Malaysia Sabah (PPST, UMS) could teach either synchronous or asynchronous classes. The independent sample t-test will be used, and the outcomes reveal statistically significant difference in the mean of both online learning strategies. Therefore, from the results we can conclude that students that prefer asynchronous learning approach improves the academic performance of students. However, higher end-of-course grades in asynchronous courses do not necessarily indicate that the asynchronous mode of instruction was more effective. This is because based on students' preference for both methods that asked in questionnaires. The results also can be affected by various factors such as blended learning that is implemented for learning.

Introduction

COVID-19's fast spread has sparked global concerns. The Malaysian government announced the closure of educational premises as a precautionary measure for outbreak control since the deployment of the Movement Control Order (MCO). This circumstance has shifted Malaysia's educational setting, posing difficulties for both educators and students. They have to adjust in shifting expectations as well as norms (Libasin et al., 2021). To guarantee that educational activities can continue, new approaches in the teaching and learning (T&L) operation must be implemented (Libasin et al., 2021). As a consequence, online education is no longer optional but it is a requirement.

Online learning can be delivered in two ways by educators.: asynchronous online learning (OL-async) and synchronous online learning (OL-sync). Singh and Thurman (2019) defined online learning (OL) as synchronous or asynchronous learning approaches that use numerous different gadgets with internet access for instance mobile phones and computers. The OL-sync implies that the mechanism for learning occurs in instantaneously, requiring both the educator and the students must be active at the same time., even if they are in different venues. However, the OL-async does not require real-time interaction. The online learning process can take place anywhere as long as there is internet access and specific devices are available (Libasin et al., 2021). When conducting remote learning, it is recommended to use synchronous support tools such as Google Meet or Cisco Webex in locations with consistent and high-speed internet access. Asynchronous assistance technologies, such as the Smartv3ums platform, could be used instead of remote learning in locations where internet access is inadequate. T&L can also be achieved by filming videos and audio and then distributing them to students through YouTube and the Smartv3ums platform.

Numerous research has been carried out to investigate how numerous learning strategies influence students' academic achievement as well as educational perspectives. Duncan et al. (2012) examined the relationship between MBA student achievement and involvement in e-learning systems, both synchronous and asynchronous. They discovered that the quality and quantity of synchronous student involvement had a greater statistical impact on overall course grades than asynchronous interaction. Buxton (2014) instead conducted an investigation on pharmacists' perceptions of synchronous and asynchronous distance learning. The survey involved 82 students with one group doing OL-sync and the other doing OL-async. According to the analysis, participants in the asynchronous course were impressed and gave their learning experiences high marks. Other than that, Berry (2017) stated in his Ph.D thesis that he evaluated educational outcome results from online Algebra 1 courses to determine whether or not there was a significant difference in end-of-course grades between synchronous and asynchronous students. Based on the results, synchronous students had slightly lower end-of-course academic performance grades than asynchronous students. (Berry, 2017)

There was not sufficient related literature for foundation enrolments in a Mathematics course to make a comparison of the preferences for OL-sync and OL-async using various learning approaches. Mathematics, as stated by Yadav (2017) is divided into two categories: pure mathematics and applied mathematics. He believes that rather only applying concepts into

practise which pure mathematics is concerned with increasing individuals' understanding of the subject, i.e., theoretical learning in applied mathematics influences the application of pure mathematics knowledge. It is only hypothetical, not real. (Yadav, 2017)

MCO, which came into place on March 18, 2020, enabled UMS educators to teach both asynchronous and synchronous classes. However, current traditional forms of learning show that conversations in person between students and instructors or classmates is still required to prevent misunderstandings in delivery and comprehension of knowledge. It also makes it simpler for them to express their ideas and opinions. This paper investigates students' academic achievements through e-learning approaches based on students' preference. E-learning approaches can be considered as asynchronous, synchronous, and blended learning. (Hussin et al., 2021)

Asynchronous E-Learning
Asynchronous e-learning is a type of self-study e-learning in which students and teachers work independently (Hun & Morris, 2009). Asynchronous learners can access content such as articles, audio/video lectures, presentations, and handouts right away. To pique students' interest, the asynchronous method enables them to save and retrieve lecture materials, as well as view the contents at their own pace, whether online or offline (Raymond et al., 2016). According to Sims and Dobbs, (2002) and Garrison, (2003), asynchronous e-learning approaches could provide a rich cognitive presence able to support efficacious and higher-order thinking.

Synchronous E-Learning
Synchronous participation encourages people to take action in group activities like brainstorming and idea exchange (Hrastinski, 2008). This e-learning ideology is organised in a way that collaboration between teachers and students. Synchronous e-learning involves both instructor-learner and learner-learner interaction. Synchronous e-learning is continuous, ongoing, and scheduled, with a focus on learning and cooperation (Shahabadi & Uplane, 2015). At the same time, Students and lecturers are in the same virtual classroom which allows synchronous information exchange for faster connection rates than asynchronous communication. (Mabrito, 2006)

Methodology

Sampling and Sample
OL-sync and OL-async techniques were common as teaching methods during the COVID-19 crisis. Students enrolled in UMS foundation studies Mathematics courses during semester 1 session 2021/2022 starting from August 2021 until January 2022 participated in this study. Off-campus students completed a course online around 6 months. The prerequisites include the students' internet connection and the topics covered in a given week. The study's total sample size was 308 students from three programmes: science (246), information technology (39), and agriscience (24). The size sample was adopted from Hussin et al. (2021). The study included 309 students, with 105 preferring the OL-sync approach and 204 preferring the OL-async approach. In this study, Google Meet or Webex Cisco were used for OL-sync, while Smartv3ums and Youtube were used for OL-async.

Data Collection Tools

Instrument

We developed a tool that can be utilised to assess online learners preferred or most commonly used mode of learning. The tool focuses on the metric used by students who are admitted to OL-sync and OL-async e-learning classes to assess academic performance based on student preferences. This determination is taken by using questionnaires towards online learning in Hussin et al. (2021). Then, at the end of the semester students' marks are analysed to measure students' achievement based on their preference in studying Mathematics subject.

Implementation of OL-sync

Google Meet or Webex Cisco

The apps of choice for the face-to-face approach, in which educators can interact with students in real time, are Google Meet or Webex Cisco. Throughout impromptu question and answer session, educators can interpret students' facial expressions to identify their level of comprehension. On the other hand, this app burden students because it utilises a lot of data.

Implementation of OL-async

Smartv3ums Platform or Learning Management Systems (LMSs)

Smartv3ums' platform is convenient to use and lighter than Google Meet or Cisco Webex. This platform allows for systematic assignment management as well as video uploading. Lecturers can share educational materials in a variety of file formats via the Smartv3ums platform, which is linked into the YouTube channel. Smartv3ums receives and transmits a wide variety of file types, including text, images, videos, links, and many others. Interacting with one another allows students to comment, share ideas, and discuss just on site.

Data Analysis

This investigation discusses quantitative research data analysis. The independent sample t-test will be used to study the impact of various learning styles using OL-sync and OL-async on PPST academic achievement of students during the COVID-19 crisis. For all analyses, the significance level was set at $p<0.05$. SPSS was used to analyse quantitative data.

Results and Discussions

The outcomes are shown both visually and numerically modes. The quantitative observation of the findings indicated in Figure 1 that students preferred the OL-asynch approach over the OL-synch approach, with 66 percent and 34 percent for both online learning methods, respectively. This determination is taken by using questionnaires since the government implemented MCO in response to the COVID-19 crisis. However, students also took part in blended learning activities. This percentage consider students' preference in questionnaires for online learning approach.

More detailed assessment is needed to examine the difference in students' academic performance between both online learning methods. Table 1 highlights the percentage of students' excellence and good, according to grades. The passing score for excellence is from A to A-, whereas the passing score for good is from B+ to C-. The finding shows that the excellence grade difference percentage is 5.2, making it difficult to conclude that there is a significant difference between the percentages of the excellence grade and good grade of these

two approaches. Apart from that, based on excellent percentage OL-asynch appears to be the best strategy since its excellent percentage is higher than the OL-synch. To verify that these are properly interpreted, additional detail analysis is performed using students' final examination scores to verify the results from Table 1.
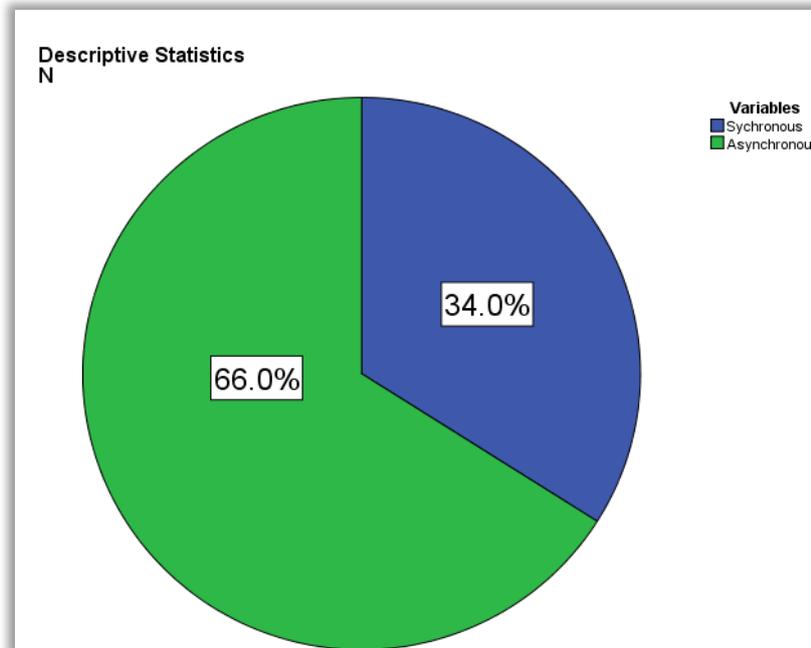
Figure 1: Students' Preferences for Online Learning Approaches.

Table 1: Percentage of Excellent and Good Grades for Both Methods

	Synchronous		Asynchronous		
	Number	**Percentage**	**Number**	**Percentage**	**Difference Percentage**
Excellence	82	78.1 %	170	83.3%	5.2
Good	23	21.9 %	34	16.7%	
Total	105		204		

SPSS is used to collect and analyse scores for both methods. Table 2 reveals that the mean of both strategies is slightly differs, with OL-synch being 80.3 and OL-asynch being 82.7. Students that prefer OL-synch had significantly lower end of course grades than OL-asynch.

Table 2: Descriptive Statistics

	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Variance**
Sychronous	105	48.00	97.00	80.3429	10.69941	114.477
Asynchronous	204	50.00	97.00	82.6765	8.82525	77.885

Table 3 showed a significant difference between the means of the two methods with a significant value of 0.0. As a result, we can draw the conclusion that the students' preference in OL-asynch approach has significant different than OL-sync. It is consistent with the findings

of Berry (2017) and Buxton (2014) which proves that online learning of the asynchronous technique will result in improved academic performance for students. This is because students can learn new things with student centred learning approach. On the other hand, it contradicts Duncan's previous study in 2012 and Libasin *et al.* (2021). It's most likely due to the courses. Various courses necessitate distinct techniques to online education. One of the most difficult dilemmas for educators is providing the most effective learning resources for students. According to Kaup et al. (2020), Hybrid learning which combines OL-sync and OL-async, will be more efficient in the teaching - learning activities. Pre-recorded videos are the most popular method among lecturers, and some even share the videos to YouTube. Then, online classroom live meetings using apps like Google Meet, Webex cisco, and Meet in Microsoft Teams are used to improve the comprehension via conversations between lecturers and students. Nonetheless, in the case of a large group of students in a class lecturers cannot track the progress of each student's knowledge and understanding of the course.

Table 3: Independent Samples t-test

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**
Asynchronous Equal variances assumed	0.846	0.359	-18.063	202	0.000
Equal variances not assumed			-15.983	42.616	0.000

Another issue is academic unethical among students when submitting assessments. Assessment is a critical component in grading students. It also provides as a mechanism for tracking students' progress and comprehension of the course. According to Rowe (2004), there are variety of methods of dishonesty, and it is inevitable, raising significant security concerns. As a result, even though there is always scope for mistrust, educators must choose to develop a trusting relationship with their students.

According to Shaikh and Raval's (2020) survey, online learning allows students to learn at their leisure, whatever the time or location, to meet their learning needs. Furthermore, introverted and passive students must raise more courageous and being more progressive all through class sessions in order for their class involvement to be started to notice and their voices to be heard.

Apart from that, the main issue is the connection to the internet. Several students live in rural areas where connection speeds are limited while others may be unable to afford a high-speed internet connection due to financial constraints. Students from poorer families, who may not be able to afford suitable devices and internet access for online learning, may struggle and thus be unable to complete the online resources prepared by their corresponding lecturers. (Libasin et al. (2021)

There are numerous online platforms for teaching and learning. Several students become disoriented as lecturers shift all of their course material and resources to their popular online platforms, requiring them to become acquainted with each of their lecturers' platforms. As a result, institutions must motivate their lecturers to utilise their respective e-learning platforms

while also limiting the number of online platforms used. However, blended learning also can be useful to students which need the students to be independent in learning or student-centred learning based. Hussin et al. (2021)

Conclusion

Both students and educators should collaborate to guarantee that learning continues in the same manner as before, but in the new norm. During the COVID-19 crisis in PPST, the use of OL-sync and OL-async strategies as a teaching medium became important. The ultimate result is that there is a significant difference between the means of both methods, with a significant value of 0.00 for $p<0.05$. As a result, we can draw the conclusion that the students' preference in OL-asynch approach has significant different than OL-sync. It is consistent with the findings of Berry (2017) and Buxton (2014) which suggests that online learning of the asynchronous technique will lead to improved academic performance for students. Higher end-of-course grades in asynchronous courses do not necessarily indicate that the asynchronous mode of instruction was more effective. This is because based on students' preference for both methods that asked in questionnaires. However, blended learning also can be useful to students which need the students to be independent in learning or student-centred learning based proposed by Hussin et al. (2021) which is consistent with Kaup et al. (2020) which the learning activities will be more beneficial. Given the pros and cons of synchronous and asynchronous e-learning approaches, blended learning using synchronous and asynchronous models should be relevant for UMS foundation-level students in studying mathematics.

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