Education

Effectiveness of asynchronous method in learning mathematics

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Abstract

The study investigated the perceptions of the Bachelor of Secondary Education 3rd year Mathematics Major students of Nueva Ecija University of Science and Technology–San Isidro Campus, second semester of academic year 2021-2022 on the effectiveness of asynchronous method in learning mathematics. The study used a total 41 Mathematics major students.

Most of the Mathematics student-respondents are 21 years old and females; use android phones and smart phones in distance learning and depend on mobile data rather than WIFI for internet connectivity. The student-respondents agreed that asynchronous method in learning mathematics subject has brought them advantages. This means that respondents coped up with this method of learning since it has been implemented and utilized for two years now.

There is no significant relationship between the profile of the student-respondents and their perceptions on the effectiveness of asynchronous method in learning mathematics subject. There is also no significant difference between the profile of the student - respondents and their perceptions on the effectiveness of asynchronous method in learning mathematics subject.

This study suggested that regardless of the profile of the students, one can be as effective and efficient in learning mathematics subject through asynchronous method. This also suggest that age, gender, gadget used in distance learning and type of internet connectivity have no relationship with the assessments of students in the effectiveness of asynchronous method in learning mathematics subject.

This study also implies that regardless of age, gender, gadget used in distance learning and type of internet connectivity, student-respondents have the same assessments on the effectiveness of asynchronous method in learning mathematics subject.

Keywords: asynchronous method, blended learning, new normal education, online learning, synchronous method

1. Introduction

Distance learning, also called distance education, is form of education in which the main elements include physical separation of teachers and students during instruction and the use of various technologies to facilitate student-teacher and student-student communication. Distance learning traditionally has focused on nontraditional students, such as full-time workers, military personnel, and nonresidents or individuals in remote regions who are unable to attend classroom lectures. However, distance learning has become an established part of the educational world, with trends pointing to ongoing growth especially when the COVID–19 pandemics hit every corner of the world.

At present, online learning resources have become a focus of vital discussion in education and research literature especially at higher education level. Young (2011) [36] stated that heads in various universities are giving immense attention on online education as an important source of teaching. These online learning resources have been revealed to be a technique to make the educational opportunities accessible to maximum students at any time and location. Online resources are now being considered as a means for improving instruction, establishing flexibility in learners' reach to instruction, and reducing the costs of instruction (Taplin, Kerr, & Brown, 2013) [32].

One article by Bonk and Zhang (2006) [8] gave pedagogical knowledge of both synchronous and asynchronous learning, in which they discuss about online methods of instruction and how learners can adjust their thoughts for online instruction. In connection with this objective, educational institutions are looking towards platforms to continue the process of educating the students, thus the digital learning has emerged. With the emergence of synchronous and asynchronous methods of learning, educational institutions can cater a wide range of students needs and capabilities in terms of distance learning.

Synchronous method of learning means that the instructor and the students in the course are engage with the course content and each other at the same time, but from different locations. The instructor interacts with students in real time by means of tools such as Zoom, Google Meet and other platforms to hold live classes or meetings. Asynchronous learning, on the other hand, means that the instructor and the students in the course all engage with the course content at different times. The instructor provides students with a sequence of units and materials which the students move through as their schedules permit. Materials make use of assigned readings or uploaded media, online quizzes, discussion boards, recorded videos, modules and more. The instructor guides the students, provides them with feedback, and assesses them as needed. Learners in this method moved through and learn at their own pace.

It is in this premise, that the researcher as a director and facilitator of learning chose to determine the advantages and difficulties of asynchronous method in learning Mathematics as assessed by BSE 3 Mathematics Major students. The researcher hopes to make the teaching process in the new normal even more effective.

2. Review of related literature

The distance education in the Philippines

In the Philippines, the Department of Education (DepEd) has applied distance learning modalities to ensure learning continuity, which involve technology and internet connection. This way, students can continue their education in remote setups through online/offline platforms, TV and radio, and printed modules. They can access these tools in various ways, such as blended learning and home schooling. In blended learning, any of these modalities are combined to maximize their benefits and achieve high-quality learning. In home schooling, students learn with the aid of a caregiver as their teacher.

Under the Commission on Higher Education (CHED), many universities and colleges have also used flexible learning systems. In such systems, remarkable changes in the learning environment during and after the pandemic are considered. Students can choose from three flexible learning modes: 1) online, which uses available online classrooms for instruction delivery; (2) offline, which involves printed modules or digital media in storage devices; and (3) blended, which combines online and offline modes.

Current issues of distance education in the Philippines

The sudden migration of education from traditional on campus learning to remote learning has put students at a great disadvantage. While universities already had great successes in establishing online learning systems for their students, it has been recognized that this transition to a new educational paradigm for most universities has not been properly organized.

Digital divide issues. Greater reliance on the Internet has tended to deepen the digital divide even further. Recent studies indicate that as more students use the Internet and other distance services, children from underserved communities (i.e., low-income and some minority students) still have much less internet exposure at home and at school than other students.

Developmental issues for students. Too much time spent on computers has been cited as detrimental to the development of relationships and social skills in children.

Variable impact on education reform. Some educators continue to believe that distance learning will lead the reform of education by changing conventional, teacher-centered approaches and developing richer, more constructivist approaches. This assumption has, however, been challenged by studies to date (Savin-Baden *et al*., 2010; Tao, Ramsey & Watson, 2011), noting that distance services are typically used to support conventional approaches. Virtual K–12 schools are a growing phenomenon, but their effect on educational reform is still hindered by issues like high dropout levels, funding conflicts, and quality-maintained policies.

In the study of Rotas E. and Cahapay M. (2020) with the title Difficulties in Remote Learning: Voices of Philippine University Students in the Wake of COVID-19 Crisis, it is found out that the participants of this research similarly voiced out unstable internet connectivity as one of the main difficulties they encounter in the practice of remote learning. The poor network is commonly a major problem for developing countries with telecommunication systems and ICT, not being properly developed (Aboagye *et al*., 2020) [1]. Although there are many existing internet bundles in the country, they are "fluctuating" and are not created equally in terms of speed and stability (Amadora, 2020) [5].

Inadequate learning resources are among the difficulties confronting the students. This result may imply that students cannot completely participate in and benefit from remote learning. This also confirms the finding of Saavedra (2020) [24] that access to remote learning devices like computers has been a recurring challenge for students as schools shift to online distance learning in the middle of a global health emergency. This problem may stem from financial-related problems as another difficulty disclosed by student participants. Noteworthy, in the Philippines, financial struggles have started to worsen for poor families during the outbreak due to an unprecedented economic shutdown (Adle, 2020) [2].

Vague learning content has also become a difficulty. According to them, this does not stem from the delivery mode but from the content itself. This could be attributed to the notion that, although university professors implemented online classes, most of them still used learning content meant for on campus learning. Overloaded lesson activities were also expressed by the students. As mentioned by them, a teacher would require them almost three activities in a subject, thus giving them less time to carefully answer them all. This difficulty in remote learning has been confirmed in the study of Sundarasen *et al*., (2020) [31] where university students in Malaysia expressed stress about the overwhelming number of assignments required by the teachers. Their findings also revealed that this difficulty had a huge impact on the stress and anxiety levels of the students. The same experience was also reported by Sarvestani *et al*., (2019) [25] where students complain about the extensive volume and the large number of modules that the need to answer. Whereas, gaining teacher support is essential for students' learning. Remote learning also needs social interaction and the exchange of ideas. However poor peer communication (Sarvestani *et al*., 2019) [25] discovered that students are having a hard time coping with remote learning because of the poor communication between them. They further posited that social issues like this influences the students' motivation and intention to study online.

Also, a poor learning environment is detrimental for students to comfortably participate in remote learning. This difficulty has been repetitively revealed in students' responses. Establishing a positive and conducive learning space has long been a problem in distance education especially in most poor households (Baticulon *et al*., 2020) [6]. If this problem occurs, study productivity and the utmost concentration of students are at stake (Chang & Fang, 2020).

Another concern of students is their compromised physical health. Students spend almost the entire day for online classes and answering activities, thus giving them less time or no time to engage in physical activities. This issue has been similarly raised by students in Malaysia where they experience strains of attending 6 to 8 hours of online classes, which further worsen

their stress level (Sundarasen *et al*.,2020) [31]. Lastly, the issue of mental health struggles was unveiled by the students surveyed. Building rapport and maintaining relationships is crucial for positive mental well-being. Unfortunately, the COVID19 pandemic has resulted in a "social recession" (Sundarasen *et al*., 2020) [31], which created prolonged social distancing patterns, thus, making emotional support probably impossible at this state. This concern is further raised in studies (Baticulon *et al*., 2020) [6] which highlighted that COVID-19 related mental health issues including depression, stress, and anxiety impacted students' motivation in online learning.

Mathematics in higher education

The development of mathematics teaching and learning has been dramatic, where in the 90s, the focus has been on computation and applying procedures in solving problems. In later stages of the 19th century and early 20th century, the conception of mathematics learning tilted from emphasis on computation towards understanding abstract concepts and relationships. This shift relied heavily on formulas to solve problems, i.e. the teaching of what and why on the conceptualization of the problems given. Then early this century, mathematical thinking has been the focus of attention. Mathematical thinking is defined as a thinking style that is guided by cognitive activities (Karadag, 2009) [15].

Singh *et al* (2016) [27] cited three studies in their paper "Teaching and learning of college mathematics and student mathematical thinking: are the lines of the same track?" and this supported, firstly, the nature of college students' understanding of basic mathematical concepts and some critical factors to be taken into account in facilitating their mathematical thinking. Secondly, the grades obtained in their transcripts for mathematics do not reflect their mathematical knowledge in problem solving. The studies signify that the current modes of teaching mathematics at colleges are not only ineffective but also seriously stunt the growth of students' mathematical thinking and problem-solving skills.

The fundamental Mathematics courses taught in colleges today for students include Calculus, Algebra, Number Theory, Topology, Logic, Geometry, Probability etc. In the study by Parmjit and Teoh (2015) [22], they elucidated that college students have learnt how to do numerical computation at the expense of learning how to think mathematically. The clinical interviews findings indicate that these students have an instrumental understanding rather than a relational understanding due to their emphasis on procedure rather than the process of learning. These courses have been taught throughout the years by instructors and students have been obtaining good grades in their transcripts (Stuart & Christopher, 2012) [30]. However, these grades in their transcript are not being translated into the development of their mathematical thinking (Devlin, 2013) [11]. There are findings related to difficulties with what in the NCTM Principles and Standards (NCTM, 2000) are denoted processes, e.g. non-routine problem-solving, proof and proving, reasoning, representing and modelling. Two of the more central, and recurrent, findings in research on problem-solving are: (i) students' focus on the rote learning of routine procedures, which is often not complemented by the development of other task-solving approaches; and (ii) students' extensive difficulties in solving non-routine problems (Schoenfeld, 1985; Lester, 1994; Selden *et al*., 1994). This unbalance seems to align poorly with most mathematics curricula goals. Although this has been well known for quite a while, this unbalance seems persistent at all educational levels (Hiebert, 2003).

According to Yackel and Hanna (2003) [35] as cited by Johan Lithner (2011) [17], there are many studies on different aspects of learning, understanding and implementing proof. Students have difficulties in differing proofs from other less rigorous types of argumentations, understanding proof statements, making the transition from informal to formal reasoning and constructing proofs. Even among university students, empirical sources of conviction (e.g. evidence from one or a few examples) dominate over more stable formal deductive reasoning (Harel and Sowder, 2007) [12]. There are also difficulties related to less formal but still central forms of reasoning, which will be exemplified below.

Types of distance learning

Many countries have shifted from classrooms to online education through online learning platforms. Even governments have promoted mobile learning as an efficient way through which students continue learning. This allowed online learning platforms to flourish. With the COVID-19 pandemic, issues on education in the Philippines have worsened. To address them, the Department of Education (DepEd) and Commission on Higher Education (CHED) have used distance learning modes, while also applying blended learning programs. These include online classes, printouts, and lessons via TV and social media platforms. Although many students and teachers prefer face-to-face classes, they have to adapt to online education as alternative learning. Online classes will continue as schools remain close. However, some of these new learning tools need internet access.

In the Philippines, the educational institutions have applied distance learning modalities to ensure learning continuity, which involve technology and internet connection. This way, students can continue their education in remote setups through online/offline platforms, TV and radio, and printed modules. They can access these tools in various ways, such as blended learning and home schooling. In blended learning, any of these modalities are combined to maximize their benefits and achieve high-quality learning. In home schooling, students learn with the aid of a caregiver as their teacher.

Even though the Internet has been the catalyst for an explosion of interest in distance learning, it is by no means the only mechanism for distance delivery. Distance learning can be done at all without any electronic assistance; at one time, it was done by studying correspondence through modules and mail. Changes in our technical capacities have contributed to incremental improvements in the way we offer instruction at a distance.

The distance learning typically took place by correspondence, according to www.oxbridgeacademy.edu.za. Nevertheless,

recent technical advances have led to an increase in the range of available tools for distance learning. In correspondence learning, the students receive learning modules, textbooks, study guides, assignments and other research materials through the post with correspondence learning. Students work at their own time and at their own pace using these resources. Depending on the institution students' chose to learn your course, he might be able to request support from a tutor or teacher through email, mobile, instant messaging, or post.

Electronic learning, also referred to as e-learning, helps students to access the content for the course on a computer. CDs, DVDs, and computer-based software can all be used for e-learning courses. Online Learning, on the other hand, is a type of electronic learning which requires students to have internet access. Often online learning is more engaging than other forms of distance learning, as it allows students to collaborate in real-time with tutors, teachers, and fellow students. Learners will also be able to access your study material from the internet through online learning, send your assignments through an online student portal, complete online tests, attend webinars, and take part in virtual classes.

Synchronous learning is where students engage concurrently with teachers and fellow students in the learning events (such as webinars and virtual classes). Asynchronous learning does not demand that students engage in learning activities at the same time. Instead, they are given the ability to work at own speed and according to own timetable, through the course material. Textbooks, email and postal communications, virtual libraries, web databases, message boards, CDs, and DVDs can all play a significant role in providing immersive distance learning courses for study content.

3. Objectives of the study

- To study the profile of respondents under study.
- To study the perceptions of the student- respondents on asynchronous method in learning Mathematics in terms of its effectiveness.
- To study the relationship and difference between the respondents' profile and their perceptions on effectiveness of asynchronous method in learning Mathematics.

4. Research methodology

A sample consisting of 41 were Bachelor of Secondary Education 3rd year Mathematics Major students of Nueva Ecija University of Science and Technology – San Isidro Campus, second semester of academic year 2021-2022.

Data collection sources

Primary data

A questionnaire is administered to the 41 respondents and primary data is extracted by this method.

Secondary data

Secondary data is collected through articles, websites etc.

Limitations of the study

- Sample size is limited
- Locale of the study is limited
- Time is a major constraint

Analysis and interpretation

Table 1: Age group of respondents

19	20	21	22	34
1	14	23	2	1

From the above table, it is evident that out of 41 respondents one or 2.40% is 19 years old, fourteen or 34.10% are 20 years old, twenty-three or 56.10% are 21 years old, also, two or 4.90% are 22 years old, and one or 2.40% is 34 years old. This implies that most of the mathematics student-respondents are between 21 years old and in the early adulthood.

Table 2: Gender of the respondents

Male	Female
11	30

From the total of 41 respondents most of them are female with 73.20% and male are 26.80%. This implies that most of the mathematics major students in Nueva Ecija University of Science and Technology San Isidro Campus Academic Year 2021-2022 are female. This reflected that more females are interested and predominant to the teaching profession than males.

It is not parallel with one qualitative study, Dave *et al*. (2012) [10] explored the reasons for a lack of females in the Science, Technology, Engineering and Mathematics fields. The researchers hypothesized that females were more likely to consider collegiate majors and careers if they believe these majors and careers make a positive impact on society and if they are exposed to female role models. Fifteen participants were engaged in 34 hands-on activities with female teachers and college-age mentors as part of the Math Options Summer Camp. The activities emphasized teamwork, design, and ergonomics in addition to mechanical engineering, steel cutting, electrical engineering, and plastic engineering workshops. The summer camp provided the participants with practical experience, the foundation to gain a better understanding of the hard sciences, and an opportunity to build confidence in their ability to succeed in a collegiate Science, Technology, Engineering and Mathematics degree program.

Dave *et al*. (2012) [10] found that participants benefited from interactions with the college student mentors, which increased their level of comfort with science. As a result of the additional exposure to math and science, many of the participants indicated that they would take math or science courses even if they were not required, and agreed that it is important for everyone to have a basic understanding of the Science, Technology, Engineering and Mathematics fields. The study reported that females were not as encouraged as males to consider collegiate Science, Technology, Engineering and Mathematics degree programs.

Table 3: Gadget used in distance learning of mathematics student – respondents

Basic cellphone	Smart phone/android phone	Smart phone/android phone, desktop, laptop
4	2	17

From the above table, it is found that the out of 41 respondents four or 9.80% use basic cellphone, twenty or 48.80% use their smart phones or android phones in distance learning, and seventeen or 41.50% use various gadget like smart phone, android phone, desktop and laptop in distance learning. This implies that most of the mathematics student-respondents uses multiple gadgets in distance learning.

Table 4: Type of internet connectivity of mathematics student – respondents

Mobile Data	WIFI
23	18

From the total of 41 respondents most of them are using mobile data with 56.10% and WIFI with 43.90%. This implies that most of the mathematics major students in Nueva Ecija University of Science and Technology San Isidro Campus Academic Year 2021-2022 are using mobile data and rely on mobile load to access data, files, video, modules and lectures sent by their professors.

Table 5: Perceptions on the effectiveness of asynchronous method in learning

Effectiveness of asynchronous method in learning mathematics	Mean	Verbal interpretation
The use of recorded videos and modules in Math class allowed me to revisit the lesson many times.	4.73	Strongly Agree
The use of recorded videos and modules in Math class promotes self - study and independent learning.	4.39	Strongly Agree
The use of recorded videos and modules in Math class helped me to be more focused on my studies.	4.07	Agree
I experienced better completion of subject or course requirement in asynchronous learning.	3.83	Agree
My critical thinking skills on subjects expanded.	3.78	Agree
The mathematics resources and materials for asynchronous learning helped me reach the course objectives.	3.71	Agree
The mathematics resources and materials provided by the instructor for asynchronous learning included a wide variety of resources and materials.	4.10	Agree
The use of recorded videos and modules in Math class helped me making up for missed lectures.	4.46	Strongly Agree
I was able to watch to the same activities and repeat them several times. Thus, I understood and learned better. It was good for me.	4.46	Strongly Agree
The use of recorded videos and modules in Math class helped me to understand the topic easily.	4.00	Agree
The use of recorded videos and modules in Math class helped me to be an independent learner and study on my own pace.	4.22	Strongly Agree
The use of recorded videos and modules in Math class helped me organize my time and learn more effectively and efficiently.	4.24	Strongly Agree
I enjoyed working at an individual pace.	3.85	Agree
Recorded videos, modules and lectures help to make my understanding of the lesson more solid and in the long term it is easier to prepare like this for an examination	4.10	Agree
I am comfortable that I am learning mathematics subject through asynchronous method.	3.66	Agree
Average Mean	4.11	Agree

From the above table, it is evident that Mathematics major students agreed on the effectiveness of asynchronous method in learning mathematics with a mean of 4.11. It is shown in the table that the respondents strongly agreed that the use of recorded videos and modules in Math class allowed them to revisit the lesson many times with mean of 4.73. It is viewed that the use of recorded videos and modules in Math class helped them making up for missed lecturer and were able to watch to the same activities and repeat them several times and they understood and learned the lesson better with mean of 4.46.

It is also revealed in the table that respondents strongly agreed that the use of recorded videos and modules in Math class promotes self - study and independent learning and helped them to be an independent learner and study on their own pace with mean of 4.39 and 4.22 respectively. It can be gleaned also that the use of asynchronous method in Math class helped them organize time and learn more effectively and efficiently with mean of 4.24.

The table also revealed that respondents agreed that asynchronous method in Math class helped them to be more focused on their studies with mean of 4.07. Respondents also experienced better completion of subject or course requirement with 3.83 and helped them reach the course objectives with mean of 3.71. Asynchronous method also helped respondents understanding more solid and make it easier to prepare for an examination with mean of 4.10. Respondents agreed that their critical thinking skills on subjects expanded with mean of 3.78 and they understand the topic easily with a mean of 4.00.

Respondents also agreed that mathematics resources and materials provided by the instructor for asynchronous learning included a wide variety of resources and materials with mean of 4.10 Lastly, respondents agreed that they enjoyed working at an individual pace with mean of 3.85 and they are comfortable that they are learning mathematics subject through asynchronous method with mean of 3.66. It implies that Mathematics major students have a positive response in the asynchronous method in learning mathematics subject and have a satisfaction in using recorded videos, lectures and modules in the subject.

The asynchronous way permits each student to study at his or her own pace and speed whether slow or quick. It therefore increases satisfaction and decreases stress (Algahtani, 2011) [3]. According to Raba (2005) [23], objectives can be accomplished in the shortest time with least amount of effort. Both learners and instructors can be able to accomplish and keep up with development as they obtain experience that is provided by numerous specialists in the various fields of knowledge.

Twigg (2002) [33] described the distance learning approach as centered on the learner as well as its design as involving a system that is interactive, repetitious, self-paced, and customizable. Some studies give advantage of this learning as its ability to focus on the needs of individual learners. For example, Marc (2000) [18] in his book review on e-learning strategies for delivering knowledge in digital age noted that one of the advantages of e-learning in education is its focus on the needs of individual learners as an important factor in the process of education rather than on the instructors', or educational institutions' needs.

It is flexible when issues of time and place are taken into consideration. Every student has the luxury of choosing the place and time that suits him/her. According to Smedley (2010) [29], the adoption of e-learning provides the institutions as well as their students or learners the much flexibility of time and place of delivery or receipt of according to learning information. It enhances the efficacy of knowledge and qualifications via ease of access to a huge amount of information. It always takes into consideration the individual learners' differences. Some learners, for instance prefer to concentrate on certain parts of the course, while others are prepared to review the entire course.

Khan (2005) [16] ensured its impact because the environments for e-learning are tolerant, so they are a good way of offering equal access to the information world irrespective of the locations of the users, their ages as well as ethnic origins, and races. The environment for e-learning also aids learners or students to depend on themselves for the reason that instructors are no longer the solitary knowledge source. They instead become advisors and guides (Alsalem, 2004).

Nieuwoudt (2020) [19] found that it did not make a difference for student achievement whether students attended synchronous virtual classes or watched the recordings of the virtual classes. However, the sheer time students participated in and interacted with the online learning system did significantly affect their academic success. Also, Northey *et al*. (2015) [21] emphasized that active participation in both synchronous and asynchronous online learning opportunities has been found to result in higher engagement and better academic outcomes than attending face-to-face classes only.

According to viewsonic.com, one of the most useful aspects of learning asynchronously is the ability to move at your own pace. This is made possible with a wide variety of digital teaching tools, which use online modules that can be checked 24/7 via phone or computer. Asynchronous learning gives a greater sense of freedom and at the same time more responsibility to students. This allows for greater opportunities for students who may have other obligations and who might not be able to attend a traditional class. Asynchronous learning is simply more practical.

Table 6: Relationship of the profile of the student-respondents and their perceptions on effectiveness of asynchronous method in learning mathematics

Profile of the respondents		**Assessments on asynchronous method in learning mathematics effectiveness**
Age	r	-.041
	p-value	.800
Gender	r	-.139
	p-value	.384
Gadget used in distance learning	r	-.016
	p-value	.922
Type of Internet Connectivity	r	.184
	p-value	.250

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

It can be seen in the table that profile of the student - respondents has nothing to do with their perceptions on asynchronous method in learning mathematics. The hypothesis of no significant relationship is accepted. It implies that age, gender, gadget used in distance learning and type of internet connectivity have no relationship with the assessments of students in the difficulties of asynchronous method in learning mathematics subject.

Results of the Pearson correlation indicated that there was no significant association between profile of the student - respondents and their assessments on asynchronous method in learning mathematics.

It is contradiction with the findings of Alghamdi *et al*. (2020) [4] that females could achieve positive perception and outcomes than males because they were more persistent and committed than males. Females had stronger self-regulation than males, which also led to their significantly more positive online learning outcomes than males.

The result also might argue with the findings of Chung *et al*. (2020) [9] wherein internet connection is one of the great challenges of learning online among students. Based on the study of Bisht *et al*. (2020) [7], problems in the internet signal might become a barrier among students in their learning. The same findings from the study of Wickramanayake and Muhammad Jika (2018) [34] indicating the unreliable internet connections are one of the barriers for students. This might

incur some significant amount in the financial standings of the students since work is also shut down and most of the families rely on relief goods and other resources from the government.

Table 7: Difference between the age of the student - respondents and their perceptions on asynchronous method in learning mathematics

Variables		Sum of squares	Degree of freedom	Mean square	F	Sig.
Effectiveness on asynchronous method in learning mathematics	Between groups	.531	4	.133	.531	.714
	Within groups	9.007	36	.250	-	-
	Total	9.538	40	-	-	-

It can be seen in the table that respondents' assessments on asynchronous method in learning mathematics were not different in terms of their age. The hypothesis of no significant difference is accepted. It implies that age has nothing to do with the perceptions of students in the effectiveness of asynchronous method in learning mathematics subject.

Results of the analysis of variance indicated that there was no significant difference in the perceptions of students for the effectiveness (F = .531, p>.05) of asynchronous method in learning mathematics.

Table 8: Difference between the gender of the student - respondents and their perceptions on asynchronous method in learning mathematics

Variables	Gender	N	Mean	Std. deviation	Degree of freedom	t-value	Sig.
Effectiveness on asynchronous method in learning mathematics	Male	11	4.2182	.48944	39	.880	.384
	Female	30	4.0663	.48980			

It can be seen in the table that respondents' perceptions on effectiveness of asynchronous method in learning mathematics were not different in terms of their gender. The hypothesis of no significant difference is accepted. It implies that the gender of respondents has nothing to do with the perceptions of students in the effectiveness of asynchronous method in learning mathematics subject.

Results of the T-test indicated that there was no significant difference in the mean scores of students for the effectiveness (t = .880, Critical Value = 2.023) of asynchronous method in learning mathematics.

Table 9: Difference between the gadget used in distance learning of the student - respondents and their perceptions on asynchronous method in learning mathematics

Variables		Sum of squares	Degree of freedom	Mean square	F	Sig.
Effectiveness on Asynchronous Method in Learning Mathematics	Between Groups	.002	2	.001	.005	.995
	Within Groups	9.536	38	.251		
	Total	9.538	40			

Table 9 shows the difference between the gadget used in distance learning of the student - respondents and their perceptions on asynchronous method in learning mathematics.

It can be seen in the table that respondents' assessments on asynchronous method in learning mathematics were not different in terms of the gadget used in distance learning. The hypothesis of no significant difference is accepted. It implies that the gadget used by respondents in distance learning has nothing to do with the assessments of students in the effectiveness of asynchronous method in learning mathematics subject.

Results of the analysis of variance indicated that there was no significant difference in the assessments of students for the effectiveness (F = .005, p>.05) of asynchronous method in learning mathematics.

Table 10: Difference between the internet connectivity of the student - respondents and their perceptions on asynchronous method in learning mathematics

Variables	Internet connectivity	N	Mean	Std. deviation	Degree of freedom	t-value	Sig.
Effectiveness on asynchronous method in learning mathematics	Mobile data	23	4.0287	.44465	39	-1.167	.250
	WIFI	18	4.2027	.53505			

It can be seen in the table that respondents' perceptions on asynchronous method in learning mathematics were not different in terms of their internet connectivity. The hypothesis of no significant difference is accepted. It implies that the internet connectivity used by respondents in asynchronous learning has nothing to do with the assessments of students in the effectiveness of asynchronous method in learning mathematics subject.

Results of the T-test indicated that there was no significant difference in the mean scores of students for the effectiveness (t = -1.167, Critical Value = 2.023) of asynchronous method in learning mathematics.

Overall result for the test of difference implies that regardless of age, gender, gadget used in distance learning and type of internet connectivity, student-respondents have the same assessments on the effectiveness and difficulties of asynchronous method in learning mathematics subject.

Several studies have investigated the effect of learners' demographic backgrounds on online learning outcomes. Numerous studies have explored the impact of gender and educational levels on online learning outcomes. Huang & Fang (2013) [14] insisted that educational levels could greatly predict online learning outcomes while the effect of gender on online learning outcomes is controversial.

Females could achieve higher learning outcomes than males because they were more persistent and committed than males. Females had stronger self-regulation than males, which also led to their significantly more positive online learning outcomes than males (Alghamdi *et al*., 2020) [4]. However, Nistor (2013) [20] found that there were no significant gender differences were revealed in learning outcomes because males were more stable in attitudes, while females performed well in engagement. Furthermore, according to Harvey *et al*. (2017) [13] there were also no significant gender differences in the learning satisfaction of online millennial learners.

Conclusion

Majority of the Mathematics student-respondents are 21 years old and females; use android phones and smart phones in distance learning and depend on mobile data rather than WIFI for internet connectivity.

The result suggested that respondents agreed on the effectiveness of asynchronous method in learning mathematics. They strongly agreed that the use of recorded videos and modules in Math class allowed them to revisit the lesson many times, make up for missed lectures and repeat them several times and they learned the lesson better. Asynchronous method in Math class promotes self - study and independent learning and helped them to be an independent learner and study on their own pace. It also helped them organize time and learn more effectively and efficiently and be more focused on their studies and experienced better completion of subject or course requirement and course objectives. Respondents agreed that their critical thinking skills on subjects expanded and they understand the topic easily that result to more solid understanding and make it easier to prepare for an examination. They are comfortable that they are learning mathematics subject through asynchronous method.

The study revealed that there is no significant relationship between the profile of the student - respondents and their perceptions on asynchronous method in learning mathematics. It implies that age, gender, gadget used in distance learning and type of internet connectivity have no relationship with the assessments of perceptions in the effectiveness of asynchronous method in learning mathematics subject.

The study also revealed that respondents' assessments on asynchronous method in learning mathematics were not different in terms of their age, gender, gadget used in distance learning and internet connectivity. It implies that age has nothing to do with the assessments of students in the effectiveness of asynchronous method in learning mathematics subject.

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