Difficulties of asynchronous method in learning mathematics

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Abstract

The study investigated the assessments 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 2023-2024 on the difficulties of asynchronous method in learning mathematics. The study used a total 41 Mathematics major students.

The descriptive research and correlation method of research were used by with the questionnaire as the main tool in the data gathering. Specifically, the study answered questions on the profile of the mathematics student-respondents, their assessments on the difficulties of asynchronous method in learning mathematics and the significant relationship and difference between the given variables.

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 difficulties.

There is no significant relationship between the profile of the student - respondents and their assessments on the difficulties of asynchronous method in learning mathematics subject.

This also suggest that age, gender, gadget used in distance learning and type of internet connectivity have no relationship with the assessments of students on the difficulties 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 difficulties of asynchronous method in learning mathematics subject.

Keywords: asynchronous method; blended learning; online learning; synchronous method

1. Introduction

It is stated that a variety of elements influence mathematics learning, but teachers play a critical role in the teaching process. People in society often believe that a mathematics teacher who is well knowledgeable about mathematics is the ideal person to teach it.

According to Stronge (2007) [25], in order for learning to occur, teachers must teach and motivate pupils. The teaching act is an interplay of a constellation of personality traits in teaching competencies, knowledge of the subject taught, the teacher's learning theories, and his or her assumption of the learners' individual differences, which leads to different teaching styles. According to Grendis and Strassfield (2002), as reported by Gundran (2003), many students enter mathematics courses with a history of failure, a perception of themselves as lousy mathematicians, and an overall distaste for the discipline and study of mathematics. Furthermore, a society that regards Mathematics in the most secretive and unnecessary ways allows these pupils to excuse the use of strategies to avoid engaging with and successfully experiencing Mathematics.

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.

2. Review of related literature

The National Council of Teachers of Mathematics (NCTM) (2000) Standards emphasize that effective teaching entails monitoring students, paying close attention to their thoughts and explanations, establishing mathematical objectives, and applying knowledge while making instructional judgments. Teachers that use these strategies encourage their pupils to think and reason mathematically, and they give learning opportunities that challenge students at all levels of comprehension. As a result, a teacher's method is one of the first topics to be examined when it comes to supporting/developing pupils' mathematical thinking. Global technological innovations and the reform activities that follow have had a significant impact on educational systems (Morewood *et al* 2010) [17].

Roblyer (2006) [20] stated that as a result, technology has grown more prevalent in educational settings. Schunk (2008) [21] also underlined that, in conjunction with changing requirements and living conditions, efforts to solve educational difficulties highlight online distance education as an alternative to present approaches.

Online learning has emerged as an important educational model in today's globalized world. It allows learners to acquire education at a lesser cost while also providing a more effective learning environment that is not limited by time or space. Online distance learning has become a widely preferred alternative due to the opportunities and flexibility it offers to individuals and communities (Newby *et al*., 2006) [19].

Two aspects that influence learning results in online mathematics courses are the presentation of mathematical concepts, problems, and process steps for answers, as well as the effective realization of student-teacher interaction (Karal *et al*., 2013) [15]. The basic concepts of mathematics education include learning about mathematical thinking methods, logical reasoning, and debate of alternate answers through student-teacher interaction. Furthermore, writing is required for mathematics (Artemeva and Fox, 2011).

Radford (2008) emphasized that mathematical thinking occurs through a sophisticated semiotic coordination of speech, body, gestures, symbols, and tools. In online distance learning, students and teachers are integrated into the system via a computer; the computer screen is used for reading and the keyboard for writing (Bernhardt *et al*., 2004). It is difficult to achieve sufficient interaction in an online learning environment by displaying mathematical concepts and symbols, which play a significant role in mathematics education, solely through use of a keyboard. This seems to be a limitation in the process of learning mathematics by online learners. Prior research reveals that mathematics instructors can have difficulty when explaining mathematical concepts visually in blended and online distance mathematics course (Karal *et al*., 2013) [15].

As online education continues to be the safest method of learning during these uncertain times, it can be sectioned off between these two categories: Synchronous Learning and Asynchronous Learning.

Synchronous learning is what you would expect of a traditional classroom setting but in an online format. The teacher and students all meet at the same time to start the learning process, interacting with each other through virtual means of video conferencing, live chatting or live-streaming lessons. In other words, the online teaching and learning happens in real-time with others present.

Asynchronous learning is the opposite of synchronous learning – all the learning happens without real-time interaction online. The learning process is up to the student and parent, as they are given online access to the materials and resources needed to cultivate the child's education. Such materials involve recorded classes, posted lecture notes, and self-guided lesson modules.

Singh and Thurman (2019) [23] interpreted the term online learning as learning experiences using various devices such as smartphones and computers with internet support in synchronous or asynchronous approaches. The synchronous approach means that the learning process happens in real-time, which requires the engagement of the instructor and the students at the same time but can be from different locations. To the contrary, the asynchronous approach does not require real-time interaction. Based on the concept of online learning, it suggests that the learning process can be implemented anywhere that has internet connectivity with the use of specific devices. For areas with stable and high-speed internet connectivity, it is recommended to conduct remote learning using synchronous support tools such as Google Meet or Cisco Webex. However, for areas with unstable internet access, they can use asynchronous support tools such as Google Classroom or Padlet as an alternative to remote learning. T&L can also be executed by recording videos and audios and then uploading them to platforms such as WhatsApp, Telegram, YouTube, or e-mail to share with students. Several studies have been conducted examining how different learning styles influence learners' academic performance and perception of education.

Duncan *et al* (2012) [12] examined the relationship between MBA students' performance and participation in synchronous and asynchronous online learning environments. They reported that the quality and quantity of student's participation in synchronous interaction had a higher statistical significance on overall course grade as compared to asynchronous interaction. Meanwhile, Buxton (2014) [9] completed a study on pharmacists' perception of synchronous and asynchronous distance learning. The study involved 82 students who were divided into two groups which enrolled one group in synchronous online learning and another group in asynchronous online learning. The study showed that the participants in the asynchronous course were delighted and rated their learning experiences more positively. To assess if there was a significant differentiation between synchronous and asynchronous students for end-of-course grades, the PhD thesis presented by Berry (2017) compared educational outcome results from online Algebra 1 courses. The research revealed that there were slightly lower end-of-course grades and standardized test scores for synchronous students than for asynchronous students.

In the aforementioned concepts and literatures cited, this study focused on the assessment of students on the asynchronous method in learning mathematics subject.

3. Objectives of the study

- To study the profile of respondents under study
- To study the assessments of the student- respondents on asynchronous method in learning Mathematics in terms of difficulties
- To study the relationship between the respondents' profile and their assessments on difficulties 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 2023-2024.

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.

5. 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 2023-2024 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) [11] 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) [11] 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 cell phone	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 2023-2024 are using mobile data and rely on mobile load to access data, files, video, modules and lectures sent by their professors.

Table 5: Assessments on the Difficulties of Asynchronous Method in Learning

Difficulties of asynchronous method in learning	Mean	Verbal interpretation
There are limited math examples in recorded videos and modules.	3.93	Agree
There is less connection and association between the students and instructors in asynchronous method.	3.88	Agree
The use of recorded videos and modules in Math class requires independent learning skills.	4.00	Agree
Follow up explanations and elaborations on the subject are delayed.	3.46	Agree
There is lack of interaction between the students and instructors in asynchronous method.	3.83	Agree
Lengthy video recordings are time consuming, tedious and boring to watch.	3.80	Agree
Slow internet connection affects learning math topics using recorded videos.	4.10	Agree
There is lack of clarifications and question and answer in asynchronous method.	3.85	Agree
There is a limited means of communication in asynchronous method.	3.98	Agree
Asynchronous method in learning mathematics requires higher level of commitment.	4.00	Agree
Personally, I find it hard to follow lectures, modules and videos about mathematics subject.	3.29	Somewhat Agree
Asynchronous method in Mathematics lessens my motivation and interest in the subject.	3.15	Somewhat Agree
Technical difficulties and low quality of videos affects my study time in Math.	4.05	Agree
Learning from a teacher synchronously is more effective than learning through e-learning resources.	3.95	Agree
Instructors' presence is essential while learning Math concepts.	4.41	Strongly Agree

Learning mathematics through e-learning resources like recorded videos and modules is more difficult than live discussions.	3.63	Agree
I find it hard to learn the subject because the course interaction with the instructor for the course would help me reach the course objectives.	3.54	Agree
Overall, I can say that my learning in Mathematics becomes limited using asynchronous method.	3.14	Agree
Average Mean	3.78	Agree

From the above table, it is evident that Mathematics major students agreed on the difficulties of asynchronous method in learning mathematics with a mean of 3.78.

It is shown in the table that the respondents agreed that there are limited math examples in recorded videos and modules with a mean of 3.93. Respondents also agreed that there is less interaction, connection, association and a limited means of communication between the students and instructors in asynchronous method.

It can be gleaned in the table that respondents believed that follow up explanations and elaborations on the subject are delayed and there is lack of clarifications and question and answer in asynchronous method with a mean of 3.46 and 3.85, respectively.

It is also revealed in the table that lengthy video recordings are time consuming, tedious and boring to watch with 3.80 and also, slow internet connection affects the respondents learning with a mean of 4.10 13. Furthermore, technical difficulties and low quality of videos affects their study time in Math with mean of 4.05 since most of the student – respondents are only using mobile data in distance learning.

Respondents also agreed that the use of recorded videos and modules in Math class requires independent learning skills and higher level of commitment with both means of 4.00.

The table also revealed that respondents somehow agreed that it is hard to follow lectures, modules and videos about mathematics subject and lessens their motivation and interest in the subject with means of 3.29 and 3.15.

Respondents agreed that learning from a teacher synchronously is more effective than learning through e-learning resources with 3.95 mean and strongly agreed that instructors' presence is essential while learning Math concepts with mean of 4.41 because the interaction with the instructor for the course would help them reach the course objectives with a mean of 3.54.

Lastly, for the respondents, learning mathematics through e-learning resources like recorded videos and modules is more difficult than live discussions with a mean of 3.63 and learning in Mathematics becomes limited using asynchronous method with the mean of 3.14.

It implies that Mathematics major students experienced some difficulties in the use of asynchronous method in learning mathematics subject. E-learning, in spite of the advantages that it has when adopted in education, also has some disadvantages. Almosa (2002) [2], regardless of all the disadvantages of distance learning, there are a lot of benefits which inspire its use and also encourage the search for ways to reduce disadvantages. Asynchronous learning as a method of education makes the learners undergo contemplation, remoteness, as well as lack of interaction or relation. It therefore requires a very strong inspiration as well as skills with to the management of time in order to reduce such effects. With respect to clarifications, offer of explanations, as well as interpretations, the e-learning method might be less effective that the traditional method of learning.

The learning process is much easier with the use of the face-to-face encounter with the instructors or teachers. When it comes to improvement in communication skills of learners, asynchronous learning as a method might have a negative effect. The learners, though might have an excellent knowledge in academics, they may not possess the needed skills to deliver their acquired knowledge to others.

Furthermore, it is believed that this method may also deteriorate institutions' role, socialization role and also the role of instructors as the directors of the process of education.

According to viewsonic.com, there are a few disadvantages when in an asynchronous learning environment. Depending on students' personality and situation may find success harder to find than normal. Isolation is a major hurdle for online learners. For those that enjoy learning alongside their peers or in social settings, asynchronous learning might take a bit of getting used to.

In general, a lot of responsibility falls upon the student to not wait until the last minute to turn in assignments, and this is especially true while learning asynchronously. While asynchronous learning more often than not has built-in communication tools to communicate with teachers and fellow students, the fact of the matter is that this communication is not always instant. Lastly, there is a limited contact with instructors with everyone being in different time zones and on different schedules. It is likely that students will be responding to emails and messages whenever available and not at the same time as your classmates.

Asynchronous teaching can enable students to work self-paced and independently of time and place (van der Keylen *et al*., 2020) but not all learners are equipped with the according strategies to benefit from this potential advantage. Learning at home, especially in asynchronous contexts, requires more self-study skills to stay on track, including enough motivation and will to follow learning goals (Hartnett, 2015) [14]. Also, students must be equipped with strong digital skills to perform academic work and successfully complete learning activities (Kim *et al*., 2019) [16].

According to Bijeesh (2017) [6], with no faculty around for face-to-face interaction and no classmates who can help with constant reminders about pending assignments, the chances of getting distracted and losing track of deadlines are high. Students need to keep motivated and focused to successfully complete distance learning course. Nagrale (2013) [18] it is not a good idea if students tend to procrastinate and can't stick to deadlines. It only requires one to be self-motivated and focused to be able to complete a course successfully (Brown, 2017) [8].

Brown (2017) [8] explained that any student seeking to enroll

for a distance learning program needs to invest in a range of equipment including computer, webcam, and stable internet connection. There is absolutely no physical contact between students and instructors as instruction is delivered over the internet.

Learners will often be studying alone and so they may feel isolated and miss the social physical interaction that comes with attending a traditional classroom. Moreover, they don't have the chance to practice the lessons verbally. The lack of physical interaction in the education process may cause many problems, such as a great degree of flaming and isolation (Dyrud, 2000) [13].

If learners ever have trouble with assignments, or questions about a lecture while in a traditional class it's generally quite simple to talk to the instructor before or after class or schedule meetings online at a different time. When learners are learning asynchronously, however, they are going to have more difficulty getting in touch with their instructor. Though they can send an email, it's definitely not going to get them the immediate response they would get if they were able to sit down with their instructor (Hutt, 2017).

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

Profile of the Respondents		**Assessments on Asynchronous Method in Learning Mathematics**
		Difficulties
Age	r	.031
	p-value	.847
Gender	r	-.079
	p-value	.623
Gadget used in distance learning	r	.116
	p-value	.471
Type of internet connectivity	r	.140
	p-value	.383

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

Table 6 shows the relationship of the profile of the student - respondents and their assessments on asynchronous method in learning mathematics.

It can be seen in the table that profile of the student - respondents has nothing to do with their assessments 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) [1] 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) [10] 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) [26] 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.

Conclusion

The study found 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. In terms of gender, from the total of 41 respondents most of them are female with 73.20% and male are 26.80%. In terms of gadget used, 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. The study also found that from the total of 41 respondents most of them are using mobile data with 56.10% and WIFI with 43.90%.

Mathematics major students agreed on the difficulties of asynchronous method in learning mathematics. They agreed that there is less interaction, connection, association and a limited means of communication between the students and instructors in asynchronous method. Learning from a teacher synchronously and instructors' presence are essential in learning Math concepts because the interaction with the instructor for the course would help them reach the course objectives.

Limited math examples and follow up clarifications, explanations and elaborations on the subject are delayed. It is also revealed that lengthy video recordings are time consuming, tedious and boring to watch and slow internet connection affects the respondents learning. Technical difficulties and low quality of videos affects their study time in Math and it is hard to follow lectures, modules and videos about mathematics subject and lessens their motivation and interest in the subject.

Respondents also agreed that the use of recorded videos and modules in Math class requires independent learning skills and higher level of commitment. The study revealed that there is no significant relationship between the profile of the student - respondents and their assessments 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 students in the effectiveness and difficulties of asynchronous method in learning mathematics subject.

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