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Synchronous and Asynchronous Modalities for Mathematics Instruction during the Covid-19 Pandemic

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Abstract: The purpose of this study was to evaluate synchronous and asynchronous mathematics teaching modalities at Isabela State University. The qualitative research method was used to collect information, opinions, and experiences of Isabela State University mathematics faculty in employing synchronous and asynchronous modes in teaching mathematical courses in terms of strengths, weaknesses, possibilities, and problems. The study's subjects were 15 Mathematics Instructors chosen at random from Isabela State University's nine campuses. A structured interview was created and distributed to participants using Google Form. The limitations on face-to-face encounters prompted the use of such data-gathering technique. The researcher followed up with another video call interview to validate the participants' responses. The data was transcribed and processed using thematic analysis. The findings demonstrated that the synchronous and asynchronous learning modalities both have strengths and disadvantages that influence the quality of the teaching-learning process throughout the epidemic. Given this, distant learning is thought to be more effective when both modalities are used rather than just one of the aforementioned. This is because the strengths of one of the two modalities can solve the flaws highlighted in the other. As a result, mathematics instructors may receive more in-depth training in both asynchronous and synchronous teaching approaches, as well as strategies for becoming more successful teachers during the present school closures.

Keywords: *Asynchronous, flexible learning, qualitative research, synchronous.*

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Introduction

COVID-19 emerged from Wuhan, China in December 2019 and quickly spread throughout the world. The virus's severity changed and affected many aspects of life, impacting the economy, tourism, health care, and educational institutions. Lockdowns forced the closure of educational institutions, such as those in the Philippines. This caused a halt in the delivery of instruction to millions of students.

As a result, educational institutions accelerated their techniques to work around the limits, culminating in the largest online movement in educational history (El Said, 2021). Flexible teaching and learning modes using digital and non-digital, synchronous and asynchronous modalities became the standard for many schools and institutions as these were the most serviceable under the current circumstances (Khalil et al., 2020). In the Philippines, higher education institutions capitalized on the educational advancements made possible by technology. Proactive policies for the continuation of education were implemented, such as the CHED Memo No. 4, Series of 2020, which gave precise instructions for the adoption of flexible learning and teaching alternatives, methods, strategies, systems, pedagogies, and modalities in schools. Proactive policies for the continuation of education were implemented, such as the CHED Memo No. 4, Series of 2020, which provided specific guidelines for the implementation of flexible learning and teaching options, approaches, strategies, systems, pedagogies, and modalities in all Higher Education Institutions, including those under permit status, in both graduate and undergraduate courses (Joquin et al., 2020).

Flexible learning is an educational strategy that allows for time, place, and audience customization. Contrary to popular belief, this method is not entirely centered on technology (Cassidy et al., 2016). Students receive access and flexibility in at least one of the following dimensions with flexible learning: time, place, pace, learning style, topic, assessment, or

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learning path (Müller et al., 2018). It entails the use of digital or non-digital modes of delivery outside of the classroom, or a mix of modes of delivery: synchronous or asynchronous teaching and learning. It supports the continuity of inclusive and accessible education when traditional methods of teaching are not practicable, such as in the event of national emergencies, as mentioned by De Vera (As cited in Joaquin et al., 2020).

Asynchronous teaching and learning allows teachers and students to access educational materials at any time and from any location during the week and does not contain a live video lecture component. Synchronous teaching and learning, on the other hand, requires professors and students to check in and participate in an online class discussion at a specified time each week. There is connection and communication between instructors and students. Online learning is described as instruction delivered on a digital device to support learning (Clark & Mayer, 2016). Numerous benefits of synchronous online learning have been noted, including the ability to teach and study from anywhere at any time (Brown et al., 2015; Ferri et al., 2020; Sadeghi, 2019). This also makes studying more convenient and accommodating, particularly for learners who live in remote places or who work as professionals. The primary distinction between asynchronous and synchronous teaching and learning is the real-time instruction component, which occurs at a predetermined time (Scheiderer, 2021).

Isabela State University, being one of the region's leading HEIs, agreed to adapt flexible teaching and learning using synchronous and asynchronous teaching modes. As part of their preparation for online classes, faculty members received training in the use of various learning management systems (LMS). This provided them with the necessary abilities for synchronous and asynchronous classes, such as using video communication platforms and video recording and editing. Some are also expected to develop course packs or modules that will be made available to students who do not have internet access.

However, despite these efforts, various issues and concerns about distant learning, particularly online classes, have surfaced, posing challenges to teachers. According to Bao (2021), the abrupt change in remote learning has resulted in obstacles, issues, and concerns for faculty members such as a lack of online teaching experience, a poor internet connection, a digital gap, early preparation, and help from educational technology teams. Students' concerns about online pedagogy include accessibility, affordability, flexibility, learning pedagogy, and life-long learning (Dhawan, 2020).

Given these obstacles, concerns, and conflicts, it is quite timely to perform a study on Mathematics professors' experiences with synchronous and asynchronous teaching. The purpose of this study was to gather information, opinions, and experiences of Isabela State University mathematics faculty in adopting synchronous and asynchronous modes in teaching mathematical topics in terms of strengths, limitations, possibilities, and problems. In this regard, the following issues were addressed in this research:

1. What were the strengths and weaknesses of the synchronous and asynchronous learning modalities used in Isabela State University during the meeting?
2. What challenges did the instructors face in using said learning modalities?
3. What opportunities emerged during the utilization of said learning modalities?

Methodology

Research Design

The researcher employed qualitative research to acquire information on the insights and experiences of mathematics teachers in terms of the strengths, shortcomings, opportunities, and challenges of employing synchronous and asynchronous modalities in teaching mathematics. According to Bradshaw et al. (2017), the qualitative design is best suited for situations in which data is sought from persons who directly encounter the phenomenon under investigation, as in the case of this study.

Sample and Data Collection

The study's subjects were restricted to 15 Mathematics Instructors chosen at random from Isabela State University's nine campuses. Letters soliciting their involvement in the study were sent to them through email, along with information about the purpose of the study and their rights if they chose to participate. However, due to the pandemic's limits, only seven of the 15 professors recruited for data collection were able to participate. Following their agreement to participate in the study, a structured interview was constructed and distributed to the participants via Google Form. The chosen data-collection method was necessary by the pandemic's restrictions on face-to-face meetings. The interview guide was limited and focus only to the strengths, weaknesses, opportunity and challenges encountered by the mathematics instructors in using synchronous and asynchronous in teaching.

The interview guide was created with reference to existing publications and studies similar to the researcher's current one. It was given to a group of university research experts for preliminary approval. Furthermore, the interview guide was pilot tested on a controlled sample of teachers.

Analyzing of Data

Transcriptions were made, and the data were evaluated using Creswell's (2013) thematic analysis. The data was thoroughly analyzed and searched for meanings relevant to the study's objectives. These meanings were then sorted and categorized into theme clusters, from which emergent themes were discovered to help inform the discussion of the interview data.

Findings / Results

In the midst of the pandemic, Isabela State University used both synchronous and asynchronous learning modalities for its students, which has provoked certain issues that demand the attention of the school administration since these are critical for excellent instruction at the institution. These issues were observed during an interview with Mathematics professors from Isabela State University's nine campuses, in which the participants expressed their experiences, views, and insights regarding using the two modalities in their classrooms.

Synchronous Learning Modality

Synchronous learning occurs in real time, with the instructor present to facilitate education for learners. Participants in the interview discussed the modality's benefits and disadvantages. They also outlined the opportunities they saw in using it and the challenges they encountered.

Table 1. Strengths and Weaknesses of Synchronous Learning Modality

Significant Statements	Theme Clusters	Emergent Themes
<p><i>"Because the teacher is right there, he can supervise the class first-hand and this allows him to gauge the learning taking place—if the students really understood the lesson; if there are areas needing more explanations and examples...things like that. The teacher can address these right away so the students learn better."</i></p> <p><i>"It's still a great advantage if you teach on real-time, especially since this is Math we're talking about."</i></p> <p><i>"Students learn more efficiently when we teachers are right there during instruction, Some concepts in Math cannot be learned independently after all."</i></p>	Direct supervision	Strengths
<p><i>"When you're there, you can easily call the attention of the students who are not very active. You can easily encourage them to take part in the discussion and to engage in the activities. This is one way of ensuring that all the students are on board with the class activities and therefore...affirming that learning is taking place."</i></p> <p><i>Many students just need that extra push for them to study and engage in activities so that is one advantage of the synchronous learning modality.</i></p> <p><i>"I found out that the students liked learning in a group setting better since they get to interact and talk with me and their classmates. I suppose being with their peers make the class more interesting compared to when they are just studying alone."</i></p>	Encourages/motivates participation	
<p><i>We can address our students concerns better during synchronous learning. And students need that kind of interaction to learn more effectively.</i></p>	Real-time interaction	

Table 1. Continued

Significant Statements	Theme Clusters	Emergent Themes
<p><i>“The connectivity problem is mutual for both sides. Even if I’m hooked on to what is supposed to be a ‘stable’ internet platform, there are times when the connection is really poor or when I’m disconnected altogether because of problems on the internet provider’s end. Usually, these long disruptions are unannounced so it’s really difficult when you’re in the middle of a class and then you get disconnected.”</i></p>	Internet connectivity	Weaknesses
<p><i>Internet connection is a big problem not just for students but also for us teachers.</i></p>		
<p><i>“The students have it harder. A majority of our students do not even have their own computers or laptops, they are usually only using their phones. It costs money to connect to the internet and on top of that, the connectivity isn’t even that great. The resolution is pixelated and the audio buffers. This disrupts the learning process because the communication of the lesson is affected to the extent that the students cannot understand what is being discussed.”</i></p>		
<p><i>“I’ve had students who had to go out of their way to just connect for online classes. Some students go out to isolated and highly-elevated spots in their towns just so they can get internet signal, just so they can attend classes. So the frustration is really there. They want to keep on studying but their situations are just too challenging.”</i></p>	Limit of resources	
<p><i>“I feel sorry for my students sometimes. They open up about their monetary difficulties, that they can’t afford gadgets for the online classes or that they don’t have enough money for load.”</i></p>		
<p><i>Many students just do not have adequate resources to afford the costs that come with this type of learning modality. Sure, it is convenient but not when you do not have enough resources like the equipment and the money for connectivity.</i></p>		
<p><i>“The memorandum from our school head stipulates 40 minutes per week only. This is in consideration for our students’ lacking resources and capabilities for accessing the internet. But this is Math we are talking about. 40 minutes is not enough for the lessons to be fully discussed...to ensure that the students understand everything.”</i></p>	Time constraints for instruction	

The table illustrates the topics detected and derived from the interview in terms of the synchronous modality's strengths and drawbacks as perceived by the participants.

Strengths

The primary advantage of the synchronous learning modality, according to the participants, is the direct teacher-learner interaction. According to a literature study, high teacher-student interaction has a favorable influence on the development of students' self-efficacy and motivation (Li & Yang, 2021); boosting their critical and problem-solving skills (Hurst et al., 2013); and improving students' academic achievement (Pervin et al., 2021).

One participant further mentioned that the direct teacher-learner relationship allows him to monitor the pupils' progress during their lessons:

“Because the teacher is right there, he can supervise the class first-hand and this allows him to gauge the learning taking place—if the students really understood the lesson; if there are areas needing more explanations and examples...things like that. The teacher can address these right away so the students learn better.”

Another respondent discussed how direct teacher-student connection in a synchronous setting promotes student participation and engagement. She stated, "

"When you're there, you can easily call the attention of the students who are not very active. You can easily encourage them to take part in the discussion and to engage in the activities. This is one way of ensuring that all the students are on board with the class activities and therefore...affirming that learning is taking place."

Under-participation has long been a source of concern for teachers during class. There are numerous reasons that contribute to this; nevertheless, the teacher is one of the primary agents who may modify this behavior among students, as the respondent mentioned in which she can better monitor the participation of the students with the synchronous arrangement. Because of the nature of mathematics instruction, close interaction between teachers and students is required. Furthermore, as another respondent mentioned, the synchronous modality made learning more enjoyable for pupils due to the social interaction that occurred:

"I found out that the students liked learning in a group setting better since they get to interact and talk with me and their classmates. I suppose being with their peers make the class more interesting compared to when they are just studying alone."

Another advantage of the synchronous mode stated by participants was the ease of accessing information for extra resources because everyone is online. This improves learning since more information is available to both the teacher and the pupils.

Weaknesses

Faulty internet connectivity and its high cost have long been a point of contention for the use of distance learning in the Philippines (Salac & Kim, 2016), and the same issue was identified as the participants' primary issue with regard to the synchronous modality they are using during the pandemic. According to one respondent:

"The connectivity problem is mutual for both sides. Even if I'm hooked on to what is supposed to be a 'stable' internet platform, there are times when the connection is really poor or when I'm disconnected altogether because of problems on the internet provider's end. Usually, these long disruptions are unannounced so it's really difficult when you're in the middle of a class and then you get disconnected."

Another explained:

"The students have it harder. A majority of our students do not even have their own computers or laptops, they are usually only using their phones. It costs money to connect to the internet and on top of that, the connectivity isn't even that great. The resolution is pixelated and the audio buffers. This disrupts the learning process because the communication of the lesson is affected to the extent that the students cannot understand what is being discussed."

Similar occurrences were also described by a respondent:

"I've had students who had to go out of their way to just connect for online classes. Some students go out to isolated and highly-elevated spots in their towns just so they can get internet signal, just so they can attend classes. So the frustration is really there. They want to keep on studying but their situations are just too challenging."

The expenses for maintaining connectivity is also a challenge for many students as many of them come from low-income families:

"I feel sorry for my students sometimes. They open up about their monetary difficulties, that they can't afford gadgets for the online classes or that they don't have enough money for load."

In addition to the aforementioned, the unpredictability of connectivity has limited the participants' capacity to discuss and illustrate mathematical topics. This is a major topic since poor class delivery significantly reduces the quality and effectiveness of learning.

The time frame is another weak element. As one respondent put it:

"The memorandum from our school head stipulates 40 minutes per week only. This is in consideration for our students' lacking resources and capabilities for accessing the internet. But this is Math we are talking about. 40 minutes is not enough for the lessons to be fully discussed...to ensure that the students understand everything."

Trenholm and Peschke (2020) also noted this circumstance in their study, stating that Mathematics training necessitates a distinct type of reflective interactivity, which has been identified as considerably beneficial in enhancing students' knowledge of Mathematical ideas. Because of the time constraints, the recursive interactivity that occurs between the teacher as he offers a question, the students' responses, and the feedback is likewise limited.

Table 2. Opportunities and Challenges of Synchronous Learning Modality

Significant Statements	Theme Clusters	Emergent Themes
<p><i>"Because of the prevalence of the online setup for learning, I had to attend seminars and workshops that trained me in different learning systems such as Google classroom, Edmodo and the like. I know that these modalities have already been utilized in the past but learning them and applying them was not really a priority back then."</i></p> <p><i>"I learned new teaching techniques for online setting."</i></p> <p><i>"The constraints of the lockdown meant that we had to make adjustments. It was very sudden but we had to learn how to make most of what we had and in a way, we were able to widen our repertoire by learning all these new methods for online learning"</i></p> <p><i>"Google meet and Zoom...Schoology...who would have thought that we will be using these fully for instruction. If there is something good I got from this pandemic, it would be the fact that I got exposed to new learning modalities such as digital literacy."</i></p> <p><i>"I wouldn't even have considered using online instruction if the pandemic hadn't happened. In a way, that is a silver lining to this pandemic."</i></p> <p><i>"We had to adjust. That means learning new methods to make sure that we can deliver to our students."</i></p> <p><i>Both students and teachers were able to learn new skills especially in digital literacy.</i></p>	<p>Skill enhancement in digital instruction</p>	<p>Opportunities</p>
<p><i>"Sometimes it gets overwhelming when there are too many technical difficulties: that the students cannot download the necessary files for our lessons; or there are difficulties in logging in. There are also many instances when audio and video quality is so poor that we spend more time on preparing and waiting for everyone to have stable connection before we can start the discussions."</i></p> <p><i>"The connectivity is really an issue."</i></p> <p><i>"It's the digital divide that is the biggest challenge here. Not all students reside in areas where internet is readily available so they do not have the same access like the others who have good internet connectivity."</i></p> <p><i>"The synchronous modality, ideally, is good. But considering the internet problems we have here in the Philippines, it tends to negatively impact learning."</i></p> <p><i>"Not everyone is properly trained for the new modality so there was really a need to adjust and in such a limited period of time too."</i></p> <p><i>"Even I, myself, am not that good with technology and I still am adjusting to using the software for the LMS. Then of course, there's the poor internet connection."</i></p> <p><i>"The new method for teaching takes a while to learn especially when you're not technology-savvy."</i></p>	<p>Prevalence of technical difficulties</p> <p>Limit of technical knowledge</p>	<p>Challenges</p>

Table 2 shows the themes of opportunities and challenges that emerged from the analysis of the participants' interview. They are as follows:

Opportunities

The participants mentioned continuing professional education and empowerment as the most important opportunities that resulted from the synchronous modality. According to one respondent:

"Because of the prevalence of the online setup for learning, I had to attend seminars and workshops that trained me in different learning systems such as Google classroom, Edmodo and the like. I know that these modalities have already been utilized in the past but learning them and applying them was not really a priority back then."

Another respondent shared the same insight:

"Google meet and Zoom...Schoology...who would have thought that we will be using these fully for instruction. If there is something good I got from this pandemic, it would be the fact that I got exposed to new learning modalities such as digital literacy."

Challenges

The most prevalent obstacle cited by participants for the synchronous modality was the issue of technical difficulties experienced by them and their students during classes: *"Sometimes it gets overwhelming when there are too many technical difficulties: that the students cannot download the necessary files for our lessons; or there are difficulties in logging in. There are also many instances when audio and video quality is so poor that we spend more time on preparing and waiting for everyone to have stable connection before we can start the discussions."*

Similarly, another respondent explained:

"Even I, myself, am not that good with technology and I still am adjusting to using the software for the LMS. Then of course, there's the poor internet connection."

Asynchronous Learning Modality

Given the personal constraints and limits caused by the pandemic, asynchronous learning is a more flexible learning modality that was implemented for the students' comfort and convenience. The following are the participants' views and insights about the modality's strengths, flaws, and opportunities:

Table 3. Strengths and Weaknesses of Asynchronous Learning Modality

Significant Statements	Theme Clusters	Emergent Themes
<i>"It's very flexible. The learning experiences are more accessible to the students since the materials like the modules and recorded videos are just posted online for the students to retrieve."</i>	Flexibility of learning	Strengths
<i>"The cognitive engagement of the student is increased as they can really take their time in exploring the course materials provided to them."</i>		
<i>"Students can study at their own phase."</i>		
<i>"The students can take advantage of the modality's flexible nature. If they are good at time management, they can accomplish academic stuff and have time for other things."</i>		
<i>"My students have access to learning materials whenever they need them because almost everything's posted online."</i>		
<i>"On my part as instructor, I have more time to prepare and design the learning materials for my students. This means that the resources I provide for them are more adequate. The same also goes for the learning tasks and assessment activities."</i>	Flexibility of instruction	
<i>To a degree, it does lessen the time for real-time lectures, that is one advantage I guess."</i>		

Table 3. Contined

Significant Statements	Theme Clusters	Emergent Themes
<p><i>"Sometimes it's difficult to tell if the student really lacks the time and resources to finish schoolwork or if he is just slacking off."</i></p> <p><i>"There are times when the students cannot follow the material or when they misunderstand it. And because I'm not there to correct them right away, they end up not learning properly at all. Given the nature of Mathematics, this happens a lot."</i></p> <p><i>"Math isn't easy to learn on your own, especially when it's a major course like the ones taken by Math major students. So that is probably one weak point."</i></p>	<p>Lack of direct and real-time supervision for student learning</p>	<p>Weaknesses</p>
<p><i>"You just don't know it but some students do cheat in quizzes and examinations. I've encountered hearsays about it lots of times: how some students send their examination links to acquaintances who are good in Math so they can answer the test for them. It's frustrating."</i></p>	<p>Academic integrity pitfalls</p>	
<p><i>"The internet is always the biggest issue of course. The timeliness of posting of activities and even students' compliance is compromised."</i></p>	<p>Internet connectivity</p>	
<p><i>"Sometimes the number of tasks is too much. It is stressful and overwhelming: checking of outputs, lesson and material preparation..."</i></p> <p><i>"I don't know if it's a matter of time management or there is really too much, but many students seem to find it hard to comply to requirements on time. They give one reason or another but I can't really tell if it's a real excuse or not. Either way, they claim that they lack the time to finish everything."</i></p>	<p>Time constraint</p>	

The table above shows the participants' perceptions of the merits and weaknesses of the asynchronous learning modality. Their findings are as follows:

Strengths

Because the asynchronous modality makes use of forum and chat mechanisms, online repositories, and movies or recorded footages that can be viewed on demand (Ebner & Gegenfurtner, 2019), it's easy to see why its users see its flexibility as its most valuable asset. As one respondent put it:

"It's very flexible. The learning experiences are more accessible to the students since the materials like the modules and recorded videos are just posted online for the students to retrieve."

Other insights that the participants shared about the modality's flexibility are as follows:

"On my part as instructor, I have more time to prepare and design the learning materials for my students. This means that the resources I provide for them are more adequate. The same also goes for the learning tasks and assessment activities."

Another respondent pointed out:

"The cognitive engagement of the student is increased as they can really take their time in exploring the course materials provided to them."

Weaknesses

Yet, the asynchronous modality's strength can also be its weakness. According to Soffer et al. (2019), flexibility does not always result in successful learning. Students may have the freedom to learn when and how they choose, but they must also be responsible enough to discipline and commit to an independent learning process. As one commenter noted:

"Sometimes it's difficult to tell if the student really lacks the time and resources to finish schoolwork or if he is just slacking off."

Another weakness of the modality that the participants cited is the lack of immediate communication between teacher and students:

“Since I am not with the students during their learning process, I get swamped with too many queries in my phone and in my messenger—to the extent that my personal time gets invaded.”

As one of the participants remarked, little and delayed communication has an impact on students' learning:

“There are times when the students cannot follow the material or when they misunderstand it. And because I'm not there to correct them right away, they end up not learning properly at all. Given the nature of Mathematics, this happens a lot.”

A respondent pointed out:

“You just don't know it but some students do cheat in quizzes and examinations. I've encountered hearsays about it lots of times: how some students send their examination links to acquaintances who are good in Math so they can answer the test for them. It's frustrating.”

Because asynchronous learning is not proctored, it might be a breeding ground for academic dishonesty. According to Farisi (2013), while the digital era brought with it the ubiquitous use of technology, it also had a role in promoting academic dishonesty, particularly in distance learning and assessment modalities. This was widely studied by Peterson (2019), whose analysis discovered that cheating is more widespread in online learning than in on-campus or online classroom settings. Subsequent investigation indicated that students 'assisted' their other students with course assignments for asynchronous courses. Kennedy et al. (2000) and Peled et al. (2019) discovered similar results.

Another drawback mentioned by participants of the asynchronous mode was the unpredictable and bad internet connection, which impedes the speedy publication of recorded videos, assignments, quizzes, and examinations in Google Classroom or Schoology.

Furthermore, the participants reported that there are times when they are overwhelmed by the number of student outputs they must evaluate.

Table 4. Opportunities and Challenges of Asynchronous Learning Modality

Significant Statements	Theme Clusters	Emergent Themes
<i>“Learning modern instructional technology like the Google Classroom and Schoology has widened my perspectives about the teaching possibilities I can learn and apply.”</i>	Skill enhancement in digital instruction	Opportunities
<i>“The new modalities we had to apply because of the pandemic gave me the chance to upgrade my teaching methods.”</i>		
<i>Personally, it was challenging for me to find ways of providing instruction apart from the usual real-time lecture. But it allowed for growth as well because I got to discover certain techniques for teaching Math that I didn't even think can be done.</i>		
<i>I learned new tools for teaching Math which I think is more suitable for 21st century learning.</i>		
<i>The pandemic really made it a necessity for us teachers to upgrade our skills...our techniques especially because we could no longer do direct lectures all the time.</i>		
<i>I think the pandemic challenged us teachers to really think out of the box and we had to rethink how we teach. That made us learn new skills.</i>		
<i>I am not very techie but because it was the only way, I had to open myself up to digital or online learning. I've gained new techniques but I'm still learning and will continue learning.</i>		

Table 4. Continued

Significant Statements	Theme Clusters	Emergent Themes
<p><i>"Monitoring my students, if they are keeping up with the learning process or not, is more difficult in asynchronous mode. And even if I do try to keep close contact, can you imagine how many student I have to monitor?"</i></p> <p><i>"It's difficult to communicate with students."</i></p> <p><i>"The lack of interaction is a problem. Unlike in face-to-face learning where you meet the students everyday and see how they're doing with the lessons and all...that's the missing element which I think affects many students a lot."</i></p> <p><i>"Students complain that they find it hard to learn on their own. I understand that because...we know that there are many things in Math that are difficult to learn on your own, right?"</i></p> <p><i>The fact that the teacher cannot directly supervise the learning is a big issue.</i></p> <p><i>Keeping track of such a large number of students individually is hard. And also, you don't know how they are keeping up with the lessons, if they are really learning or not.</i></p> <p><i>I think not everyone works well alone. Especially in learning Math. So the isolation, that affects the students' performance and motivation.</i></p>	<p>Monitoring difficulties and effect of social isolation</p>	<p>Challenges</p>

The table below shows the opportunities and obstacles that participants encountered when using the synchronous learning modality. These are their names:

Opportunities

Participants, like those identified in the synchronous learning modality, named professional improvement in digital literacy as the biggest opportunity they obtained from using asynchronous training. As one of them put it:

"Learning modern instructional technology like the Google Classroom and Schoology has widened my perspectives about the teaching possibilities I can learn and apply."

Challenges

The participants highlighted social isolation and delayed contact between the teacher and students as the key reasons for the asynchronous modality's issues. As an example:

"Monitoring my students, if they are keeping up with the learning process or not, is more difficult in asynchronous mode. And even if I do try to keep close contact, can you imagine how many students I have to monitor?"

Discussion

Strengths of Synchronous Learning Modality

The primary advantage of synchronous learning is direct teacher-learner interaction. According to Apriliyanto et al. (2017), social interaction is vital in Mathematics instruction because it helps the teacher to guide students through critical thinking processes and to reflect on their knowledge of the issues at hand. This idea is similar to Vygotsky's zone of proximal development (ZPD), which states that education is more successful when the instructor works with children at the stage of development where they require the assistance of an expert to master future skills and concepts (Kusmaryono et al., 2021).

This phenomena could be explained by what Burgess et al. (2018) refer to as "social contagion" in the academic arena. Social contagion is frequently mentioned in regard to motivation because some experts believe that behavior such as motivation is contagious or catching in the classroom setting; so, if some students exhibit interest in a topic, others are likely to follow suit. Mendoza and King (2020) investigated this with secondary school pupils and discovered a substantial association between social contagion and classroom participation. This was also the case in one respondent's experience.

Weaknesses

Internet connectivity was indicated as the participants' primary issue in terms of the synchronous medium they are employing during the pandemic.

Given the constraints for face-to-face mass gatherings, it is the most pressing issue during the pandemic when education has been translated to online modes. Furthermore, as Arayata (2021) stated, the problem is exacerbated for teachers and pupils in rural areas, where the majority of people can only access mobile data because more stable internet providers are not yet available. The unpredictability of connectivity also limited the participants' capacity to discuss and illustrate mathematical topics. This is a major topic since poor class delivery significantly reduces the quality and effectiveness of learning.

It should be mentioned that in a face-to-face classroom setting, the teacher illustrates mathematical topics on the board with notations and illustrations. This is not always the case in distance learning. The communication flow in an online arrangement is different, according to Trenholm and Peschke (2020), because mathematics is abstract and works best with a visuospatial instructional design. Since that internet availability is already an issue, the teacher's use of other technical tools may make access and communication quality even more challenging for the pupils. Trenholm and Peschke (2020) also noted this circumstance in their study, stating that Mathematics training necessitates a distinct type of reflective interactivity, which has been identified as considerably beneficial in enhancing students' knowledge of Mathematical ideas. Because of the time constraints, the recursive interactivity that occurs between the teacher as he offers a question, the students' responses, and the feedback is likewise limited.

Opportunities

The most crucial and opportunities in the usage of synchronous mode are continuous professional education and empowerment. Mathematics faculty members are always learning and improving their knowledge and skills in digital teaching literacies. During the pandemic, the preference for digital literacy rose by leaps and bounds as educational institutions faced the problem of continuing to give instruction despite community lockdowns and quarantines. As stated by the participants, this required them to adapt and adopt remote learning modalities such as those indicated above.

According to König et al. (2020), effective use of ICT has become an essential skill for teachers to exercise their profession during school closures. As a result, different teacher empowerment activities such as seminars and training programs have been launched to assist.

Teachers' adaptation to the paradigm shift. As Sánchez-Cruzado et al. (2021) pointed out, digital literacy training programs were required for teachers to obtain the requisite digital abilities. This was especially important for teachers who lacked appropriate expertise of such modalities.

Challenges

Both instructors and students frequently face technical obstacles during synchronous teaching and learning. The provided are not unique to the circumstances of the participants, as they have been recognized as obstacles for the synchronous modality by other professors even before the epidemic. Park and Bonk (2007) cited tool-related and network connectivity issues as inconvenient aspects of synchronous learning deployment. Similarly, in his examination of the learning modality, Dhawan (2020) identified the following as prevalent technological obstacles: audio and video difficulties, installation and log-in problems, and downloading mistakes.

Strengths of Asynchronous Learning Modality

One of the benefits of the flexible nature of the modality for both teachers and students is that students can access the learning materials and resources at their disposal, while teachers have more time to develop quality instructional materials, learning tasks, and assessment activities for their classes. According to Soffer et al. (2019), the flexibility of asynchronous courses enables students to make customised choices in their learning process, resulting in personalized learning.

Weaknesses

While asynchronous learning has been linked to the development of students' motivation and autonomy (Moreno-Guerrero et al., 2020), some studies, such as those from Ariyanti and Santoso (2020) and Libasin et al. (2021), have also revealed that it may not be as effective in improving students' mathematical achievement as the synchronous modality. This was also mirrored in the cases of the participants, as evidenced by their statements.

Furthermore, the participants discussed academic dishonesty and how students are prone to committing it because they are not directly supervised and guided by their teachers.

Because asynchronous learning is not proctored, it might be a breeding ground for academic dishonesty. According to Farisi (2013), while the digital era brought with it the ubiquitous use of technology, it also had a role in promoting

academic dishonesty, particularly in distance learning and assessment modalities. Peterson (2019) discussed this extensively.

9 discovered that cheating is more common in online learning than in-person or online classroom settings, and further investigation revealed a trend of students 'helping' their fellow students with course work for asynchronous courses. Similar findings were also seen in the studies of Kennedy et al. (2000) and Peled et al. (2019).

Opportunities

Participants, like those identified in the synchronous learning modality, named professional improvement in digital literacy as the biggest opportunity they obtained from using asynchronous training. As one of them put it:

"Using modern instructional technology such as Google Classroom and Schoology has broadened my thoughts on the teaching opportunities I can learn and implement."

Challenges

Delays in feedback are a common issue for both professors and students, especially when it comes to correcting mistakes or clarifying misunderstandings regarding the teachings. What is particularly troubling about this is the risk that the social isolation of students in asynchronous learning environments would lead to them dropping out of their studies entirely. This was observed in Ali and Smith's (2015) study, which evaluated the attrition rate between students in face-to-face classroom settings and distant learning settings.

Another concern that was noticed was academic dishonesty. According to Ravasco (2012)'s research, a fully online style of higher education learning is something that many students can readily master due to their nature as digital natives; thus, there is always the chance that they can get around it. For example, research has found that students frequently engage in plagiarism and unlawful intellectual networking while completing assignments.

Conclusion

The strengths and drawbacks of synchronous and asynchronous learning modes influence the quality of the teaching-learning process during the pandemic. The common virtues of synchronous and asynchronous include direct teacher-learner interaction and teaching and learning flexibility, respectively, while the common flaws are poor internet connectivity and a lack of interaction and communication with professors and students. Yet, the finest opportunity acquired by the Mathematics Faculty from using synchronous and asynchronous education was constant professional growth and development through attending trainings and workshops in diverse learning systems and digital literacy. Given this, distant learning is regarded to be more effective when both modalities are used rather than just one of the aforementioned. This is because the strengths of one of the two modalities can solve the flaws highlighted in the other.

Recommendations

In light of the study's findings and conclusions, the researcher suggests that teachers receive more in-depth training in both asynchronous and synchronous teaching approaches, as well as strategies for being more effective in teaching during the present school closures. Also, they should learn preventive methods for academic dishonesty among students, as this is one of their primary concerns when employing online teaching.

Limitations

The seven subjects chosen by purposive sampling are one of the study's weaknesses. The participants are Associate Mathematics Professors from Isabela State University's nine (9) campuses. Their responses to several questions about the strengths, shortcomings, possibilities, and challenges they encountered when using synchronous and asynchronous teaching modalities represent the experiences of other mathematics instructors on their respective universities. Furthermore, the study excludes students' perspectives on their own strengths, flaws, opportunities, and obstacles. As a result, data alone are insufficient for reaching broad generalizations.

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Appendix

Semi-Structured Interview Form

I. Preliminaries

A. Self-introduction

B. Reaffirming of participant's consent for interview and pointing out of respondent's rights during the interview

II. Interview Proper

A. Participant's perspectives on the strengths and weaknesses of synchronous and asynchronous modality of learning

B. Participant's perspectives on the opportunities they found in synchronous and asynchronous modality of learning

C. Participant's perspectives on the challenges they found in synchronous and asynchronous modality of learning

III. Ending Gramercies