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Research Article

Synchronous and Asynchronous Learning amidst the Pandemic: Students' Level of Satisfaction and Academic Achievement in Mathematics

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Abstract: This study aimed to identify the students' level of satisfaction as well as their academic performance in the synchronous and asynchronous learning modalities implemented for them in Isabela State University. The mixed-method research design was used in the study. The quantitative descriptive design was used to evaluate the mathematics achievement and performance level of the students; while the qualitative method of the interview was used to identify the strengths and weakness in using synchronous and asynchronous modalities in learning. Two groups of students participated as respondents: 25 students from the Bachelor of Science in Entrepreneurship assigned as Group A and 40 from the Bachelor in Agricultural Technology assigned as Group B. The respondents' mathematics achievement were based on the results of their quizzes in the aforementioned topics as well as on their preliminary, midterm and final examinations. With this, it was revealed that the respondents performed slightly better through synchronous learning. As for the students' level of satisfaction, a SWOC analysis was used in examining their responses from the interview. Common strengths included the learner-centered nature and flexibility of the modalities. Weaknesses include technological, financial and learning-related issues. Meanwhile opportunities identified included digital literacy and cultivation of coping and independent learning strategies. Challenges identified related back to the issues cited in the weaknesses.
Keywords: Asynchronous learning, GEC, Mathematics achievement, Students' satisfaction, SWOC, Synchronous learning.

Introduction

Given the alarmingly rapid spread of COVID-19, the World Health Organization declared it a global pandemic on March 11, 2020. Government agencies all over the world mandated strict social containment measures and this resulted to an unprecedented re-structuring of education delivery as educational institutions had to undergo closure. This new norm brought about challenges, problems and opportunities for the academic sector especially with regards to the teaching-learning process. For an instance, school closures resulted to a widespread venture of educational institutions into the world of distance and online learning. While said modalities have been around for some time, it was only during the pandemic that they gained a strong traction given the restrictions of the current times. Even before the pandemic, various studies have already been undertaken to investigate the utilization of distance learning especially in higher education. The study of Mahlangu (2018), for an instance, deliberated on the effect of computer-supported learning among college students. Therein, it was stated that distance learning programs increases the access of students to higher education, however the limitations of the modality has been seen in the teaching of courses in laboratory sciences. As Dumford and Miller (2018) also stated, distance and online learning benefits specific types of engagement but prove to be deterrent to others. In particular, they found out that online courses

increased the quantitative reasoning ability of students. On the other hand, it limits the exposure of students to meaningful social interactions and effective instructional practices from teachers.

Due to the aforementioned, the implementation of flexible learning seems more advantageous. According to Muller *et al.,* (2018) for example, flexible learning, just as the term itself suggests, enables students to gain better access to learning with regards to time, place, pace, learning style, content, assessment and learning path. In the Philippines, this became the authorized modality for tertiary education as accorded by the Commission on Higher Education, specifically in the issued Memorandum no. 4, Series of 2020 which guidelines in the implementation of flexible learning and teaching options, approaches, Strategies, systems, pedagogies, and modalities in all Higher Education Institutions in both graduate and undergraduate including those under permit status.

In Isabela State University, the students are subjected to both synchronous and asynchronous modalities. The university president mandated this through the issuance of Memorandum no. 252, Series of 2020 which ordered the implementation of a 40-minute one-day online lecture for each course with the rest of the week consisting of asynchronous and modular learning activities. This shift has brought with it an opportunity for the academic sector to fully investigate the impact of asynchronous and synchronous learning arrangements for students in higher education. As Veletsianos and Houlden (2019) mentioned, flexible learning have been a topic of study in the last 40 years as there are various questions and issues not only about its impact but also how it is defined and practiced. This is due to the fact that the concept of flexible learning is in constant evolution given the modernization of instructional practices and the development and inclusion of technology in education, especially the internet (Naido, 2017).

The synchronous learning modality being applied in ISU at present was called VIRI classroom in the study of Francescucci and Rohani (2018) with VIRI standing for virtual, interactive, real-time, instructor-led classroom. The primary aim of a VIRI classroom is to replicate the teaching-learning experience of the face-to-face classroom. Through virtual classrooms such as those offered by technologies such as Zoom, Skype, Blackboard Collaborate and WebEx Training Centre, just to name a few, teachers can host video and audio-enabled classes in which students can join in. In the said study, the performance and engagement outcomes of students in VIRI courses and face-to-face learning modalities were compared; and the results showed that the performance of the students in both modalities were similar. However, those in the VIRI group showed less engagement compared to the students in the face-to-face group. Meanwhile, a meta-analysis conducted by Martin *et al.*, (2021) identified a statistically small but significant effect of synchronous learning to the cognitive outcomes of students in comparison to asynchronous learning.

The asynchronous learning modality, on the other hand, is characterized by its emphasis on independent learning as students work autonomously in their own pace and in separate spaces (Clark, 2012). Course information and materials, meanwhile, are made available online for student access. DeNeui and Dodge (2006) investigated the impact of such modality on the performance of students and they found out that there was positive impact as perceived in the test scores of the respondents. Similar results were seen in the study of Suresh *et al.*, (2018) in which the learning delivery was cited as the foremost advantage of the modality: since the learning content and materials are online, learners have more control of their learning process.

In view of the aforementioned literature, the researcher took an interest in identifying and analyzing the strengths, weaknesses, opportunities and challenges in the utilization of synchronous and asynchronous learning modalities in Isabela State University, specifically in the teaching of Mathematics. Given the nature of the times, it is expected that distance learning is the new norm for educational institutions not only in the Philippines but also all over the world. Since this is the case, the researcher conducted this study for the purpose of providing empirical insights that can help ISU improve its learning delivery to the students and, as a result, improve their performance as well.

Objectives of the Study

The main objective of the study is to assess in the use of Synchronous and Asynchronous Learning Amidst Pandemic and its effect on students 'academic achievement and performance in mathematics. Specifically, it aimed to:

1) Evaluate the mathematics achievement and performance of the students enrolled in GEC 3-Mathematics in the Modern World;
2) Compare the mathematics achievement of the students exposed in synchronous and asynchronous learning.
3) Determine if there is a significant difference in the mathematics achievement of the students exposed in synchronous learning and students exposed in asynchronous learning; and
4) Identify the strengths, weaknesses, opportunities and challenges encountered in engaging synchronous and asynchronous modalities.

Methods

The mixed-method research design was used in the study. Said design was identified as the most fitting for the purpose of the study since the quantitative method using descriptive design was needed to collect, tabulate and analyze the data, particularly in evaluating the mathematics achievement and performance level of the students. On the other hand, the qualitative method using the interview was also necessary to identify the strengths and weakness in using synchronous and asynchronous modalities in learning. Two groups of freshmen were tapped as participants: 56 from the Bachelor of Science in Entrepreneurship assigned as Group A and 40 from the Bachelor in Agricultural Technology assigned as group B. Both groups were subjected to alternate synchronous and asynchronous modalities.

From the total number of enrolled in each course/group, the researcher identified students who are actively participated in synchronous and asynchronous learning. This was determined through their attendance and quizzes during their synchronous sessions and though the timeliness of their quiz submissions for the asynchronous sessions. From this, 25 students from each group were chosen as respondents of the study. Said students also garnered a final grade that belonged to the 85-90 range.

The exposure of the respondents to the learning modalities in GEC 3 Mathematics in the Modern World is illustrated as follows:

Topics	**Synchronous**	**Asynchronous**
Patterns and Numbers in Nature and the World	Group A	Group B
Expressions Vs Sentences	Group B	Group A
Inductive and deductive Reasoning	Group A	Group B
Measure of Central Tendency (Grouped Data)	Group B	Group A
Recognizing and Analyzing Geometric Shape	Group A	Group B
Simple and Compound Interest	Group B	Group A

The respondents' mathematics achievement are based on the results of their quizzes in the aforementioned topics as well as on their preliminary, midterm and final examinations. On the other hand, their mathematics performance was based on their final grades in the course. These were tabulated and analyzed using frequency counts and t-test to determine the significant difference in the mathematics achievement and performance of the students after their exposure to synchronous and asynchronous learning. Meanwhile, for the qualitative part of the study, data gathered from the interview was analyzed using thematic analysis. The transcripts of the interview were organized, synthesized, and search for the common statements and ways of thinking.

Results and Discussions

Students' Performance and Achievement in GEC 3 Mathematics in the Modern World

Table 1. Respondents' Mathematics Performance

Score Range	I	A		B	
	Interpretation	**Frequency**	**Percentage**	**Frequency**	**Percentage**
1.25-1.5	Outstanding	2	8%	1	4%
1.75-2.0	Very Satisfactory	11	44%	7	28%
2.25-2.5	Satisfactory	8	32%	11	44%
2.75-3.0	Fair	4	16%	6	24%
Total		**25**	**100%**	**25**	**100%**

Table 1 reveals that there are 2 or 8% of the respondents in Group A had outstanding performance in Mathematics while there is only 1 or 4% in Group B which garnered the same performance. Furthermore, the table also illustrates that most of the students in Group A have very satisfactory performance in GEC 3 and 11 or 44% of the students in Group B have a satisfactory performance in the subject.

The data indicates that the respondents in Group A perform better in Mathematics compared to their peers in Group B. It is to be noted that the two units of respondents are grouped according to their college program.

In relation to this, Pagtalunan (2018) determined in her study that students' college program has a highly significant correlation to the determinants of their learning in Mathematics in the Modern World. But just like in the current study, Roman and Villanueva's (2019) research also indicated that freshmen students displayed satisfactory performance in the subject with minor difficulties on some competencies.

Table 2. Difference of Respondents' Mathematics Achievement in Synchronous and Asynchronous Modalities

Topics	Mean		Mean Difference	t-value	Interpretation
	Synchronous	**Asynchronous**			
Patterns & Numbers in Nature and the World	18.80	16.20	2.60	1.67	.1037 ^{ns}
Expressions vs. Sentences	11.75	13.70	1.95	3.56	.0010 ^{s}
Inductive & Deductive Reasoning	11.80	12.15	0.35	0.91	.3666^{ns}
Measure of Central Tendency (Grouped Data)	24.45	23.55	0.900	0.87	.3882^{ns}
Recognizing and Analyzing Geometric Shape	10.10	8.55	1.55	1.41	.16651 ^{ns}
Simple and Compound Interest	14.20	13.60	0.60	0.53	0.6010^{ns}

Table 2 shows the mathematics achievement of two groups of respondents in 6 topics in GEC 3-Mathamatics in the Modern World. As shown in the table, respondents exposed to synchronous learning performed better in *Patterns Numbers in Nature and the World*, *Measures of Central*

Tendency, *Recognizing and Analyzing Geometric Shapes* and *Simple and Compound Interest* respectively with mean scores of 18, 80, 24.45, 10.10 and 14.20 in comparison to the mean scores of 16.20, 23.55, 8.55 and 13.60 of the respondents exposed to asynchronous learning.

Meanwhile, students exposed to asynchronous learning obtained higher scores in the topics *Expressions vs. Sentences* and *Inductive and Deductive Reasoning* with mean scores of 13.70 and 12.15 respectively in comparison to the mean scores of 11.75 and 11.80 for the respondents exposed to synchronous learning.

The said results concurred with Berry's (2017) findings that students exposed to synchronous learning modalities achieve slightly lower scores compared to their counterparts who underwent asynchronous modalities. Similarly, Ogbona *et al.,* (2019) also posited that students taught through the asynchronous mode displayed higher cognitive achievement.

When the data was subjected to the t-test however, it was found out that there is no significant difference in the mathematics achievement of the students exposed in synchronous and asynchronous modalities in topics 1,3,4,5,6 as evidenced by computed p-values greater than .05. On the other hand, there is a significant difference in their mathematics achievement in topic 2 with the p-value being less than .05. This is due to the fact that there were slightly lower scores for synchronous students than for asynchronous students.

These findings may be attributed to various factors but for one thing, as Berry (2017) found out in her study, some students preferred asynchronous learning because on the fact that it gave them the ability to learn at their own pace, and to do course work when they were ready. This might have been the case with the respondents of the current study.

Table 3. Difference of Respondents' Scores in the Preliminary, Midterm and Final Examinations

Major Examinations	Mean		Mean Difference	t-value	Interpretation
	Group A	Group B			
Preliminary	40.31	39.58	0.731	0.38	.7085 NS
Midterm	26.96	21.77	7.192	2.83	.0067S
Final	38.27	34.96	3.308	0.93	.3557NS

Table 3 indicates the respondents' scores on their major examinations in GEC 3 Mathematics in the Modern World, specifically in their preliminary, midterm and final examinations. As illustrated, Group A performed better than Group B on their preliminary and final examinations with a mean difference of 0.731 and 3.308 respectively. On the other hand, Group B performed better on the midterm examination with a mean difference of 2.83. Moreover, although Group A performed better on the preliminary and final examinations, analysis revealed that there is no significant difference in the preliminary and final performances as evidenced by the p-value which was greater than .05. There was, however, a significant difference for the midterm examinations with the p-value less than .05.

This corresponded to the respondents' statements that the synchronous modality was better for them because it gave them the opportunity to participate actively in lecture discussions and interactions. Also, they appreciated the immediate feedback and the structured schoolwork schedule afforded by said modality. In the study of Lobel *et al.,* (2005), these were also the same advantages cited for the asynchronous modality.

Strengths, Weaknesses, Opportunities and Challenges in Synchronous and Asynchronous Learning Modalities

Table 4. Perceived Strengths of Synchronous and Asynchronous Learning

Synchronous	Asynchronous
Real-time discussion, communication and sharing of ideas among learners and instructor	Learning can take place anytime, anywhere and in accordance to students' own schedule
Opportunity for clarification	Video lectures may be paused enabling students to take their time in solving mathematical problems
More evident connection with peers and instructors which promote engagement with course activities	Individualized learning minimizes distractions from peers and allows students to concentrate more
Direct supervision from instructor	Access to varied learning materials and references
Minimization of rushing to physical classes	Development of time management among students
Easier and faster sharing of resources	
Access to additional resources through the internet during class	

Table 4 shows the respondents' perspectives regarding the strengths of the synchronous and asynchronous learning modalities they experienced in studying GEC 3 Mathematics in the Modern World. Said strengths were outlined in the table according to what respondents ranking of the foremost strengths of the modality.

The respondents consider the real-time nature of discussion, communication and sharing of ideas in the virtual classroom as the asynchronous modality's foremost strength. This is followed by the immediate opportunity for them to ask for clarifications about the lesson being discussed; the evident connection with peers and instructors which motivates them to engage more; and the direct supervision from their instructor. All the aforementioned are elements typical in the face-to-face setup and since the students experienced this kind of modality in their preceding school years, it is understandable that it is something they are partial to.

It should also be noted that good teacher-student relationships are essential in developing student motivation and in improving their academic achievement; and these relationships are developed from daily classroom interactions (Pennings *et al.,* 2014). This was one of the problems cited in distance learning, hence the application of synchronous modalities via virtual classroom setups which allowed for real-time interactions among students and their instructors. And as cited by the respondents, this provided them with supervision from their instructor as well as faster feedback in case of questions and clarifications about the lesson at hand.

Another strength cited was the minimization of rushing to go to physical classes since the classroom is virtual and the students take their classes at the comfort of their own homes. The respondents also mentioned that resources are easier to share in the synchronous setting and that additional resources that can aid them in learning are accessible through the internet.

Meanwhile for the asynchronous mode, the respondents identified the flexibility of individualized learning as its foremost strength. As Armstrong-Mensah *et al.,* (2020) also stipulated in their study, the flexibility of the modality was a feature that students appreciated since they can learn anytime, anywhere and in accordance to their own pace or schedule.

Aside from flexibility, the respondents cited the unrestrained time they can spend in learning through the lecture videos uploaded by the instructors. The respondents appreciated the fact that they could pause said videos, giving them ample time to reflect on the topic or even to look for additional

resources online to help them understand the lesson better. This is in opposition to what usually takes place in the face-to-face modality in which most instructors would continue discussing while some students are still processing what was said. In relation to this, the respondents also mentioned that the asynchronous modality minimized the distractions they usually encounter in the face-to-face setup since they are studying alone. Furthermore, they also mentioned access to online resources as a strength of the modality.

Finally, the respondents cited that asynchronous modality helped them develop skills and habits in time management. As posited by Ahmad *et al.,* (2019), one of the primary achievements of distance learning is the development of effective time management among students. This is especially advantageous for them since effective time management is significant in improving learners' academic performance and achievement.

Table 5. Perceived Weaknesses of Synchronous and Asynchronous Learning

Synchronous	Asynchronous
Unstable internet connection	Minimized classroom discussion, interaction and communication
Technical difficulties due to lack or unavailability of reliable Wi-Fi providers	Limited or inadequate understanding of lesson
More evident connection with peers and instructors which promote engagement with course activities	Minimal and belated feedback on questions and clarifications of lessons
Distraction from feedback noise or sounds from other classmates' devices	Lecture video quality lessened by poor and slow internet connection
Lack or unavailability of gadgets and budget for Wi-Fi load	Development of time management among students
High price of load for Wi-Fi connection	Overloading of assignments and assessment tasks
Minimization of student participation due to time limit of classes	Minimal tracking of learning progress
Learning pace is not within the students' control	Feeling of isolation and demotivation due to lack of social interaction with classmates and instructor
Too many LSMs and apps required by the different courses	Overwhelming learning contents
Stress and exhaustion from overexposure to electronic devices needed in studying	Stress and exhaustion from overexposure to electronic devices needed in studying
Students chatting about topics not related or irrelevant to lessons	

The table above indicates the respondents' perceived weaknesses to the two modalities ranked according to what they consider as each mode's foremost flaw.

In synchronous learning, the instability of internet connectivity was what the respondents considered most detrimental. This was followed closely by related issues such as the technical difficulties they experience due to the unreliability of the internet providers in their area. According to Rotas and Cahapay (2020), the implementation of distance learning has revealed the digital divide among students and these inequalities have become the primary barriers to effective instructional delivery during the pandemic. This is also related to the 5th and 6th weaknesses identified by the students: the lack or unavailability of gadgets and budget for Wi-Fi and the high price of load for Wi-Fi connection. As Baticulon *et al.,* (2021) pointed out, many students belong to middle-to low-income families hence the biggest concern for them are the unavailability of reliable internet connectivity

and device ownership. In fact, their study revealed that one of 10 students actually lacked even the most basic needs such as food, water, medicine and security.

The respondents also identified the distractions they encounter from the background noise of their classmates' surroundings as well as the lack of time for everyone to fully participate in the discussion. It is to be recalled that ISU instructors were mandated to hold a maximum of 40-minute synchronous classes for each subject only—thus justifying what the respondents stated. In relation to these, the respondents also consider their lack of control over their learning pace as a weakness of the synchronous modality. Other weaknesses identified include the number of LSMs and apps they have to manage for their different subjects, stress and exhaustion due to overexposure to electronic devices and students chatting about irrelevant topics during class time.

As for asynchronous learning, the foremost weakness identified was the absence of frequent classroom discussion, interaction and communication which is also related to the second weakness cited: the prospect of limited understanding of lessons and minimal and belated feedback on questions and clarifications of lessons. Appanna (2008) discussed this partially in her study, stating that not all students are cognitively prepared for asynchronous learning since the modality requires self-directed learners who are fully capable for independently managing their time and learning. Furthermore, the impersonal and isolating nature of the modality was also perceived to be detrimental as it not only limited the exposure of students to the spontaneous and real-time communication but also caused substantial delays in feedback which is crucial in the scaffolding of learning. Furthermore as Baticulon *et al.,* (2021) stated, students usually find that studying topics independently is more difficult compared to studying topics that have been discussed first by their teacher. Similarly, the aforementioned were also cited by the respondents as criticisms for the modality, specifically ranking them as the 7th and 8th weakest points.

Aside from the aforementioned, the respondents also identified the poor quality of the lecture videos as a problem. While said resources are uploaded online and are made readily available for student access, the problem lies in the poor internet connectivity which reduces the quality of the lecture videos or even prevents access to these resources altogether.

It is also notable that although the respondents mentioned the development of time management skills as a strength of asynchronous learning, some of them also classified it as a weakness. Baticulon *et al.,* (2021) discussed this in their study explaining that studying at home may not always equate to more time on the part of the students. This is due to the possibilities that they may have chores at home or that their home life is not conducive for learning.

The increased number of schoolwork and the overwhelming learning contents were also singled out as one more weakness of the asynchronous modality. The same issue was also identified as one of the themes that emerged when the difficulties of students in distance learning in the study of Al Kumain *et al.,* (2021), in which it was found out that 69.5 percent of the university students who participated as respondents expressed feelings of being overloaded with information and work while undergoing distance learning. The aforementioned is also the most probable cause for the last problem identified by respondents which is their stress and exhaustion from overexposure to electronic devices needed in studying.

Table 6. Perceived Opportunities in Synchronous and Asynchronous Learning

Synchronous	**Asynchronous**
Learning innovation	Individualized pace in learning
Development of independent learning among students	Literacy in digital platforms
Student-centered instruction	Flexibility in learning
Fostering of digital skills and literacy	More efficient learning

Table 6 indicates the opportunities that the respondents perceived in synchronous and asynchronous learning.

In synchronous learning, the respondents showed awareness and appreciation for the learning innovation they undergo through the virtual classes. As cited by Toquero (2020), the nature of the synchronous modality presents the academe with the chance to promote better learning. After all the synchronous modality has ushered in the extensive use of technology at a regular basis (Francisco & Barcelona, 2020): something that was not fully practiced pre-pandemic.

The respondents also recognize that the current setup helps them develop independent learning skills as they cited this as one of the opportunities they found in synchronous learning. For an instance in the study by Barrot *et al.,* (2021), it was determined that the challenges of the current learning setup have driven students to develop coping strategies such as resource management and utilization, help-seeking, time management, technical skill enhancement and learning environment control.

Aside from the aforementioned, the respondents also identified the student-centered instruction as an opportunity for them. While the synchronous modality capitalizes on the lecture method as the primary means of instruction, the respondents' opinion that it is learner-centered implies that their instructor uses interactive and innovative strategies with them. As Liu (2008) stated, the alternative approaches used in distant education can make it a channel of promoting learner-centered education. This can also be related to the last opportunity identified which is the fostering of digital skills and literacy among the students.

With regards to asynchronous learning, the respondents cited its individualized nature as the best opportunity. As rationalized by Joaquin *et al.*, (2020), the asynchronous modality might have its challenges but the opportunities that emerge from it cannot be discounted altogether. Similar to what the respondents stated, the study of Joaquin et al. stipulated that asynchronous learning is the best context in fostering free-flowing thought that moves beyond the restricted confines of the classroom. This means that students can study and learn at their convenience at a reasonable time frame accorded by their schools.

Another opportunity mentioned was the development of literacy in digital platforms. It is to be noted that while the idea of distance and independent learning has existed pre-pandemic, its potentials have not been fully explored. It is only now that it had become the default instructional modality that its capacities are being tested in full. This is especially true in terms of digital literacy since students have come to realize the possible learning experiences they can gain from the digital world.

For the respondents, the flexibility of the synchronous modality afforded them more learning. As Fidalgo *et al.,* (2020) explained, the self-paced study time, as well as the time and space adaptability allow learners to develop a learning system that works for them.

Table 7. Perceived Challenges in Synchronous and Asynchronous Learning

Synchronous	Asynchronous
Unstable and slow internet connection	Unstable and slow internet connection
Adequacy of budget for Wi-Fi access	Compromised academic integrity due to cheating in assessment tasks
Possibility of compromising quality of learning and knowledge acquisition	Expensive costs of availing gadgets and internet technology
Digital illiteracy and divide	Possibility of compromising quality of learning and knowledge acquisition
Unfamiliarity with gadgets and apps used	Adequacy of budget for Wi-Fi access
	Exhaustion from prolonged electronic device use

Table 7 presents the challenges that the respondents encountered in synchronous and asynchronous learning.

As aforementioned, the unstable and slow internet connection as well as the adequacy of budget for Wi-Fi access are the foremost problem areas for the respondents in the synchronous modality. This is also related to the 4th and 5th challenges they cited, which are the digital divide and the unfamiliarity with the gadgets and apps needed for their learning. Given this, they also cited that there emerged the challenge of having their learning and knowledge acquisition compromised. The aforementioned have also been cited in studies by Baticulon *et al.,* (2021), Joaquin *et al.,* (2020) and Fidalgo *et al.*, (2020).

Similar challenges were cited for the asynchronous modality. Aside from the aforementioned however, the respondents also identified the potential for compromising academic integrity due to cheating issues for the assessment tasks. Academic dishonesty has also been the concern of many studies about distance learning. Peterson (2019) for an instance, states that academic dishonesty has gone beyond copying answers or papers. With the technological innovations of the 21st Century, students have developed more innovative ways of committing academic dishonesty at a faster and easier rate.

The last challenge cited by the respondents is their exhaustion from prolonged electronic device used. This is due to the fact that most of the learning materials and resources for them are accessed online.

Conclusions

In light of the discussion of findings, the researcher came up with the following conclusions:

1) First, while both modalities have characteristics that complement and address each other's strengths and weaknesses, the results on the performance of the respondents indicate that the synchronous modality is more advantageous in promoting proficiency in GEC 3 Mathematics in the Modern World. This may be attributed to the fact that the teaching of Mathematics require a unique combination of verbal and non-verbal cues as well as concrete discussions and demonstrations for it to be fully understood by learners. While lecture videos are made available for students in the asynchronous modality, it should be noted that the lack of real-time interaction prevents the learners from asking for clarifications or more explanations from their instructor in times when they cannot understand the topic at hand. This might also be another reason for the better performance of students taught synchronously.
2) As for the SWOC analysis conducted in the study, the findings indicate that the experiences of the students are similar to that of other students undergoing the similar learning modalities. The strengths, weaknesses, opportunities and challenges identified herein have also been perceived in other studies not just in the Philippines but also in academic institutions all over the world. In consideration to this, it is a given that the educational sector not only monitor the implementation of said learning modalities; they should also put into place mechanisms that would address the issues identified so as to make learning more effective even during the pandemic.

Recommendations

In accordance to the aforementioned, the researcher highly suggests the following:

1) That instructors be guided and trained further so that they can deal with the instructional problems that crop up in synchronous and asynchronous learning;
2) That more flexible approaches be used for lectures in the asynchronous modality so as to minimize the inconvenience brought about by the unreliability of the internet. Apart from the lecture videos which require stronger connectivity, some lessons may be taught using podcasts or self-instructional modules and lecture guides instead; and
3) That instructors show consideration in the amount of schoolwork they give to students as they also have other courses to study.

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