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COPING MECHANISMS OF MATHEMATICS STUDENTS DURING THE COVID-19 PANDEMIC

MARK ANTHONY A. SORIANO
Isabela State University – Cabagan Campus

ABSTRACT

This study aims to explore and understand the coping mechanisms of Mathematics students during the COVID-19 pandemic to craft interventions for adaptive instruction in mathematics. It specifically sought to identify the challenges students faced with Mathematics education during the pandemic, investigate how tertiary students coped with learning Mathematics during this period, and determine the necessary interventions to improve Mathematics education under these circumstances. This study employed a qualitative, phenomenological research design to explore the challenges and coping mechanisms of Mathematics students during the pandemic. In-depth face-to-face and phone interviews were conducted to uncover the underlying meanings and emotions associated with the participants' coping strategies. The qualitative data collected from these interviews were analyzed using Braun and Clarke's Thematic Analysis.

The findings indicate that during the COVID-19 pandemic, students encountered significant challenges in online mathematics education due to technological issues, distractions, and difficulties with digital literacy, which they addressed through strategies like using mobile data, finding better signal areas, and creating quieter study spaces. Despite their efforts, many faced frustration and decreased motivation, exacerbated by barriers to communication and collaboration with peers and teachers, highlighting the importance of effective time management and support from their community.

This research project holds significance as it offers crucial insights into the challenges faced by Mathematics students and their coping mechanisms amidst the COVID-19 pandemic. These insights are pivotal for developing effective intervention programs and support systems aimed at sustaining educational continuity and ensuring quality during future crises. Furthermore, the findings will inform the implementation of resilient and adaptable educational practices tailored to meet the diverse needs of students in times of uncertainty.

Keywords: *challenges in mathematics education, coping mechanisms, COVID-19 pandemic, intervention programs and support systems, mathematics education*

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INTRODUCTION

The year 2020 brought one of the people's worst nightmares, the COVID-19 pandemic. This pandemic brought fear and dilemma to every person in every country and certainly changed the world. It altered human behaviors, relations and lifestyles as massive gatherings were prohibited and people were forced to distance themselves from others.

People worldwide had to adapt to the new normal, with community lockdowns and quarantines leading to students and teachers working and studying from home. This shift led to the integration of various online platforms, including e-learning, virtual labs, and digital or technological connections, in the learning processes (Ray & Srivastava, 2020; Crawford et al., 2020; Nuere & de Miguel, 2020; Schneider & Council, 2020). The Commission on Higher Education (CHED) in the Philippines granted academic freedom to its higher education institutions (HEIs) and mandated the implementation of available distance learning, e-learning, and other alternative modes of delivery to students (CMO No. 4 s. 2020). Consequently, different HEIs opted to develop and use their own learning management systems, with the Cagayan State University (CSU) choosing to use the Learning Environment Network System (LENS) and other distance learning platforms like modular and online learning via Zoom and Facebook to deliver instructions to its students. Other HEIs used platforms like Edmodo, Google Classroom, and Schoology, among others.

As per Bao's (2020) observations, the adoption of online learning brings forth various risks, problems, and challenges, particularly for students. She noted that students are likely to face challenges in adapting to online learning due to inadequate learning attitude, self-discipline, suitable learning resources, or favorable learning spaces, especially when they have to self-isolate at home.

Students during the COVID-19 pandemic relied on coping strategies, often developing their own methods (Baloran, 2020). Nyatsanza and Mtezo (2013) stress the importance of these strategies for students facing educational challenges. Tria (2020) highlights the critical role of educational institutions in addressing issues during crises like COVID-19, emphasizing the need for effective strategies to ensure quality education and prepare for future uncertainties. The adaptability of students, teachers, and stakeholders is crucial for maintaining educational quality during the pandemic. Many schools were unprepared for the sudden shift, lacking technological readiness and necessary resources for online learning, which impacted the quality of education provided. Hence, this paper aims to seek and understand the coping mechanisms of Mathematics students during the pandemic to come up with an intervention program to sustain quality education in times of uncertainty.

Statement of the Problem

This study aimed to explore and understand the coping mechanisms of Mathematics students during the pandemic as a basis for crafting interventions toward adaptive instruction in mathematics.

Specifically, it sought to answer the following:

1. What are the students' challenges with Mathematics education during the pandemic?
2. How do tertiary students cope with learning Mathematics during the pandemic?
3. What intervention must be employed to improve Mathematics education during the pandemic?

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METHODOLOGY

Research Design

This study employed a qualitative research design with a phenomenological approach to deeply explore and understand the coping mechanisms of Mathematics students during the pandemic. Phenomenology is chosen as it allows for an in-depth investigation of participants' lived experiences, providing valuable insights into the subjective aspects of their coping strategies and interactions. This section elaborates on the use of phenomenology.

Sample and Sampling Procedure

The primary sources of data for this study consist of ten students from Cagayan State University, specifically from the Carig and Andrews campuses. These two campuses are considered central campuses of the university since they are located in Tuguegarao City, capital of Cagayan, and they cater variety of students from the different municipalities and city in Cagayan as well as from the other provinces since they offer almost all program offerings of the university. Thus, considered as representations of the university.

The sampling method employed for this study was purposive sampling. Participants were selected based on their relevance to the research objectives and their ability to provide rich insights into coping mechanisms. This method is justified by the need to gather in-depth and meaningful data from Mathematics students who have directly experienced the challenges of the pandemic. Purposive sampling is in accordance with the phenomenological approach, as it permits the selection of participants capable of providing insightful descriptions of their experiences.

The researcher identified specific criteria for participant selection, ensuring alignment with the research goals. These criteria were tailored to identify individuals capable of offering profound and detailed descriptions of the phenomenon under investigation.

Data Gathering Procedure

The researcher initiated the process by seeking formal permission from relevant authorities, such as the academic institution and ethical review board, to conduct the study. This step ensures that the research adheres to ethical standards and institutional guidelines for conducting research involving human participants.

With the assistance of Math instructors and professors, the researcher established contact with potential participants. The preferred mode of contact (in-person and phone call) was determined in consultation with educators. Once contact was established, the researcher explained the purpose of the study, and the significance of the participants' contributions, and requested their willingness to participate in an interview. Upon obtaining participants' consent, in-person and phone-call interviews were arranged. The researcher conducted face-to-face and via phone call interviews to allow for a more personal and insightful exploration of participants' challenges and coping mechanisms related to Mathematics education during the pandemic. Participants were informed in advance that the interview would be recorded to ensure accurate data capture. The interviews were conducted informally, adopting a conversational approach that encourages participants to share their experiences candidly. This approach aimed to create a comfortable environment where participants feel at ease expressing their thoughts and emotions. The conversational style facilitated a deeper understanding of participants' coping strategies and the contextual factors influencing their experiences. The interviews were guided by a semi-structured

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interview guide, which included open-ended questions designed to explore participants' challenges, coping strategies, and possible interventions. One central research question was developed: "How do you find mathematics learning during the COVID-19 pandemic?" The purpose of a semi-structured interview guide is to provide a framework for the interviewer to cover specific issues, or topics relevant to the research objectives. The researcher actively listened, probed for details, and encouraged participants to elaborate on their responses to capture the nuances of their experiences.

During the interviews, audio recording equipment was used to capture participants' responses. Subsequently, the recorded interviews were transcribed verbatim, ensuring that the rich narratives, emotions, and nuances were preserved for analysis. Moreover, to ensure the rigor of data gathering as to validity and reliability, the research revisited the respondents to clarify or confirm that the data gathered and analyzed are the ones that they have said and agreed.

Throughout the data-gathering process, ethical considerations were important. Participants' informed consent was obtained before the interviews, and their identities were kept confidential. They were assured that their participation was voluntary, and they could withdraw at any point without repercussions.

To dig deeper into the possible interventions to improve Mathematics education during the COVID-19 pandemic, five faculty members, three of which are also part of the administration, were also asked for their insights.

Data Analysis

The goal of the research is to allow the study for deeper and better understanding of the student's challenges in learning Mathematics and how they cope up during the COVID-19 pandemic. In this study, the data collected was from the in-depth interviews that were conducted to attain holistic, extensive knowledge of the experiences of the students during the pandemic. In reviewing each transcript, the researcher highlighted major points, areas of questions, and explored thoughts regarding the experiences of the participants. The researcher analyzed coding to find emerging themes within the interview transcripts, such as those regarding the experience of the participants. The data was analyzed following Braun and Clarke's (2006) thematic analysis procedures, which include familiarization, coding, theme generation, theme review, theme defining and naming, and writing up. By following this rigorous and systematic approach to thematic analysis, the researcher ensured that the data analysis was thorough, reliable, and insightful, providing a rich understanding of the participants' experiences and perspectives.

RESULTS AND DISCUSSION

I. Students' challenges with Mathematics education during the pandemic

As the researcher incorporated the data collected from the respondents, six themes were identified as challenges students faced with Mathematics during the COVID-19 pandemic: (1) Technological Challenges, (2) Ineffective Online Learning Platform and Tools, (3) Student Engagement and Communication Barriers, (4) Challenges in Learning and Understanding, (5) Psychological and Emotional Impact, and (6) Noise and External Distractions.

The first theme highlights challenges related to access to technology and reliable internet connectivity, including weak internet connections and unavailability of gadgets. The second theme

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addresses issues with digital platforms and tools used for online education, including portal-related problems and lack of digital literacy, while the third theme focuses on difficulties in active participation and effective communication, often exacerbated by poor internet connections. The fourth theme covers obstacles in comprehending and mastering academic material, especially mathematics, in an online environment. The fifth theme presents the mental and emotional challenges due to the pandemic and the transition to online learning, which have impacted students' ability to learn effectively. The sixth theme describes the distractions that hinder students' concentration during online learning sessions, including uncontrollable external factors affecting their focus.

Technological Challenges

Internet Connectivity Issues. After the lockdown due to COVID-19, academic classes transitioned from face-to-face to online, leaving people unprepared and hindering the quality of education. One significant issue was internet connectivity, with frequent reports of weak or unstable connections affecting both students and professors. For instance, P1 stated, "it is not clear when the professor discusses. The problem is not clear because the technical issues on the internet." Similarly, P2 remarked, "during pandemic is about the internet, sir. When the internet connection is weak, it (studying Math) is difficult." P4 noted, "It was quite hard sir, especially I was learning online virtually and sometimes the signal is unstable therefore it was very hard to cope with the lessons." P5 highlighted, "then the internet, sometimes, is very unbalanced (inconsistent). Like now, it's strong and then when you pass (activities) suddenly, it disappears…" P6 expressed a decrease in interest due to frequent logging or disabling of the internet, saying, "My issue during lessons, because once it's online and the device logs or the internet connection is disabled, it seems like it's hard to follow the lesson, sir. That's why I don't feel like studying anymore, sir." P7 added, "when it comes to connection... it's hard to understand sometimes when you lost the (internet) connection like that." P8 emphasized, "My first problem actually, sir, is the signal. During discussion, we don't understand anything especially in our subject in statistics, because the discussion is always interrupted." P10 concurred, "And the connection, consistent interruption." P9 pointed out, "...I had a hard time because there are internet connections that interrupt the professors' speech(lecture)."

Resource Limitations. The transition to online classes during the COVID-19 pandemic exposed significant resource limitations among students. Many had to rely on mobile phones for their studies, lacking access to laptops or other essential technologies necessary for online class. Mathematics often requires specific software or programs that are not readily available on mobile phones, emphasizing the need for appropriate technological resources. P1 mentioned, "Because there is no Excel... Sometimes, there is no laptop to use." P4 commented, "I use my phone. But the phone's screen is small." P10 described, "just discussing what is flashed (on screen) but sometimes Ma'am is holding a white board but sometimes it's small on the screen so I can't see it that much..." P5 added, "Then not all of us have laptops. Not all of us have Wi-Fi. So, that's what really became the problem, being far from each other and then having nothing to use." P8 remarked, "It's not possible on cellphone. Since when it is downloaded the features are not complete like the ones on the laptop."

These limitations significantly hindered students' ability to fully engage with and benefit from their education, as highlighted by studies showing the negative impact on academic performance and overall satisfaction with online learning (Balais, 2023; Barrot et al., 2021).

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Ineffective Online Learning Platforms and Tools

Challenges with Online Learning Platforms. Students and educators faced difficulties with portals, issues with submission processes, and the inadequacy of some platforms for educational purposes during the pandemic. These challenges often resulted in frustration, missed deadlines, and decreased engagement, highlighting the need for more effective and user-friendly online learning environments. P1 and P6 highlighted issues with the timing and functionality of online portals, with P1 stating, "But one time our problem was that he (the teacher) suddenly, as if it was in advance. It was set for one week and then, we were just surprised, sir, that the portal was already closed," and P6 adding, "But there is an instance that sir has a style where he suddenly pins the deadline (on the portal). So, when you log in, you will be surprised." P8 observed challenges faced by both students and professors, saying, "There are teachers who are also new to using gadgets, like platforms. So, there is the experience that our teacher is not prepared also," and describing access issues with Moodle, "But I feel sir, that's in the cite itself. Because Moodle is used, sir. It's like I'm being denied access to that. Then I was no longer able to pass using Moodle, Sir."

The narratives of the participants revealed significant challenges associated with online learning platforms during the pandemic. Issues with portal functionality, submission processes, and the overall suitability of platforms for educational purposes created barriers to effective learning. This analysis can be supported by two relevant studies. Barrot et al. (2021) and Sabio and Sabio (2024) found significant challenges faced by students in the Philippines during the pandemic, including limited digital literacy and skills. Some students lacked the necessary technical skills to effectively navigate online learning platforms and tools, hindering their ability to engage fully with online learning, access digital resources, manage time effectively, and stay motivated. Furthermore, Sabio and Sabio (2024) found that teachers' lack of digital literacy and training in using technology for online teaching-learning purposes significantly hindered effective online learning.

Student Engagement and Communication Barriers

Lack of Student Engagement and Interaction. During the pandemic, student engagement and interaction have notably declined due to hesitancy in asking questions, challenges in direct communication with professors, and a sense of disconnect, impacting their educational participation and quality of learning. P1 expressed frustration with delayed responses from classmates, stating, "…sometimes it's also difficult sir like when they do not reply immediately like you need an answer now so you can change whether your answer is right or wrong…" P10 echoed difficulties, noting, "Sometimes it's difficult in terms of communication because we only talk through messenger and we don't know each other very well yet." These sentiments were further echoed by P4 and P9, who discussed issues with platforms like Facebook Live and messages getting lost. P9 elaborated on the perception of teachers being unapproachable online, stating, "Most teachers and professors are also difficult to approach when it comes to learning." In addition to communication barriers, students expressed hesitancy in seeking assistance from professors and peers. Participants mentioned feeling embarrassed to ask questions in the online format.

These experiences highlight several challenges impacting student engagement in online

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learning such as reluctance to ask questions, communication barriers, and difficulties in peer interactions, all contributing to reduced student involvement. Barrot et al. (2021) found that limited interaction among students and teachers hindered online learning, leading to feelings of isolation and detachment from the learning process. Technical issues, inadequate internet connectivity, and limited access to digital devices further compounded these challenges, making it harder for students to engage effectively with online learning platforms.

Challenges in Learning and Understanding

Mathematics Learning Experience. The transition to online learning during the pandemic significantly impacted students' experiences with learning mathematics. Many students found it increasingly difficult to understand and solve mathematical problems. P1 noted, "When the professor's discussion is a bit vague, so you need to do more research... sometimes what the proof gives is also vague." Similarly, P2 shared, "Sometimes I had a hard time understanding it. Even though I tried several times to understand it, sir. It seems that I understand a little, sir. But not to the point that I understand it perfectly." The narrative of P4 and P7 highlight the inherent difficulty of mathematical content, particularly when it involves complex elements like algebraic expressions. P4 admitted, "I am having a hard time trying to understand the lessons especially when it comes to numbers with letters, I find it hard." P7 echoed this sentiment, stating, "I am having a hard time trying to understand [the lessons]." P9 discussed the difficulty of finding the right resources and aligning them with the professors' preferred textbooks. The variation in authors' teaching styles and the abundance of online resources make it challenging to find consistent and comprehensible materials. "Probably to find the topics and the authors of the preferred books of our professors. Each author of the books that our professors use has their own style. That's why I'm having a hard time," explained P9. The shift from face-to-face to online learning also impacted students' ability to keep pace with the course. P5 highlighted this challenge, saying, "...when it shifted from face-to-face to online, that is where I started to struggle to keep up with the pace because there was no face-to-face guidance." P10 reflected on the difficulty of catching up on missed lessons, crucial in mathematics where understanding builds on foundational concepts. "I didn't understand the first lessons... I had a hard time catching up with the topic because I didn't quite understand it," shared P10.

Participants described heightened challenges in learning mathematics during the pandemic, including unclear instructions, complex content, lack of face-to-face guidance, and difficulties accessing consistent resources. These narratives align with Meniano and Tan's (2022) study, which highlighted students' struggles with difficult mathematical concepts, particularly those involving variables and exponents, during remote learning. Similarly, this sub theme discusses the challenges of learning mathematics during the pandemic.

Comparison of Experiences. The shift from face-to-face to online learning during the pandemic has led to notable differences in students' learning experiences, with many findings online learning significantly more challenging. As P1 said: "I don't know but it was difficult, mathematics was difficult before the pandemic. Although it was face-to-face, I had a hard time personally." P2 and P3, in particular, emphasized that the face-to-face mode allowed for better understanding through direct interaction and frequent activities, and they were less hesitant to ask questions. P2 stated, "Before the pandemic, sir, it's easier to understand, during the face-to-face part, sir, I'm not shy to ask, sir." While P3 added, "In face to face, I understood better when we

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were always doing activities. I understood better then. But when it comes to online classes when the pandemic started, I couldn't understand it very well because it doesn't retain in my head."

The experiences shared by the participants collectively demonstrated the increased challenges of online learning compared to face-to-face instruction. Even though mathematics was already tough before the pandemic, the sudden transition to online has made it harder. Students struggle with less interaction, a disconnect between lectures and assessments, and reduced retention of information. Moreover, students globally, including those from regions like Pakistan and Indonesia, have also encountered numerous barriers in online mathematics education. These obstacles include inadequate access to stable internet connections, a scarcity of essential devices, waning motivation, and difficulties comprehending online educational resources (Sujadi et al., 2022; Murtiyasa and Lathifah, 2023).

Psychological and Emotional Impact

Psychological Impact. The shift to online learning during the pandemic has not only posed academic challenges but has also significantly impacted students' mental health. Many students have reported increased anxiety, stress, and decreased motivation, which have affected their overall well-being and academic performance. As P5 narrated, "I wasn't happy with math before." P4 and P9 expressed anxiety about their academic performance, particularly in mathematics. The pressure to perform well in online activities and assessments has increased their stress levels, which has a negative impact on their mental health. P4 articulated, "I was very anxious about the answers, about the grades, the scores I will get from my activities.". Similarly, P9 shared, "My mental health went down during that moment. And I don't have the passion for learning at that point" P9 further added that the subject itself affected mental health, stating, "The very math subject is what affected my mental health, maybe because of consistently unable to get the answer".

The accounts shared by P4, P5, P9, and P10 underscore the profound psychological toll of online learning. Increased anxiety, decreased motivation, feelings of isolation, and a lack of happiness and passion for learning are prevalent issues among students. Research conducted by Embalsado et al. (2022) reinforces these observations, revealing that the sudden shift to online education has precipitated mental health crises, including breakdowns, a sense of academic inadequacy, and a perception that online learning is more demanding than traditional classroom settings. These factors have collectively contributed to a decline in students' mental well-being.

Emotional Impact. Students had increased feelings of frustration and fear of falling behind, and pressure leading to a loss of confidence and interest in the subject matter during the pandemic. P1 expressed difficulty in keeping up with discussions, stating, "It's also difficult to get behind from the discussion." P5 shared feelings of isolation and loss of interest when support was lacking, remarking, "No one helped me who knew better than me. So, it's like I lost, at first, interest." P9 described the overwhelming pressure felt as a freshman, stating, "For me, it seems like the pressure was too high at that time... It"s overwhelming on our part as students." P10 articulated increased irritability and frustration when struggling with lessons, saying, "It's like because I don't understand the lessons, I'm irritable... It's like I'm not myself."

The narratives from the participants highlighted the significant emotional impact of online learning on students. Increased frustration, fear of falling behind, pressure, and loss of motivation are common experiences that can lead to a decline in confidence and interest in the subject matter. Additionally, research conducted by Bakkialakshmi and Sudalaimuthu (2022) corroborates these

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findings, indicating that the pandemic-induced shift to online education has intensified feelings of anxiety, loneliness, and a sense of disconnection among students. The absence of face-to-face interactions and physical contact has notably contributed to these emotional challenges.

Noise and External Distractions

Noise Distractions. Attending online classes at home has been part of the policy of online learning in the pandemic. Background noise from neighbors, dogs barking, construction work, and household activities can interrupt learning sessions, making it difficult for students to stay focused. The following narratives from P1, P3, P4, P7, P8, P9, and P10 illustrate these challenges and their impact on students' online learning experiences.

P1 mentioned, "those who play loud music and there were dump trucks passing by," while P4 explained, "There are lots of construction around the house, that is why it is hard to listen." Household noises also posed significant challenges. P3 mentioned distractions from their dogs, while P7 and P8 cited noisy neighbors affecting their focus. P10 elaborated on the cumulative effect of household disturbances, stating, "And there are times where someone suddenly entered my room. So, the online class is very difficult." P9 discussed their sensitivity to noise and its impact on their attention span, noting, "Because I have very short attention span. Once someone enters my room or there is just a little noise, I immediately become distracted and it will be difficult to focus on synchronous learning."

External Distractions. Distractions from external sources resulting in difficulty in concentrating. These distractions can range from engaging in unrelated activities online to dealing with the presence of family members in the learning environment. As P3 described, *"I can't seem to control myself to watch other things, then suddenly you're on TikTok already."* Meanwhile, P2 highlighted the issue of multitasking, where juggling multiple tasks simultaneously often leads to poor time management and missed deadlines. The constant switching between tasks can diminish the quality of work and increase stress levels. *"There are multiple tasks. The deadline of this is close, okay (meaning she's going to work on it). That is why sometimes I submitted it late." P2 explained.*

Additionally, P9 emphasized the challenge of adapting to a home learning environment where the presence of family members can be distracting. "What I can only say about my learning when it comes to mathematics right now is quite difficult. Since, first is in my environment. I'm not used to my family being there while I'm studying," P9 stated.

The narratives demonstrate that external distractions, whether from engaging in unrelated online activities, poor time management due to multitasking, or an unsuitable learning environment at home, significantly impact students' ability to concentrate during online learning. Moreover, the transition to online learning in the Philippines amid the COVID-19 pandemic has revealed specific challenges related to noise levels and distractions among students. Research by Piamonte et al. (2022) underscores that noise exposure significantly increases the difficulty of task performance for students, indicating a moderate positive correlation.

II. Strategies used by tertiary students cope with learning Mathematics during the pandemic

Five themes are identified for strategies used by tertiary students cope with learning Mathematics during the pandemic: (1) Resource Utilization, (2) Support Networks, (3) Self-Directed Learning, (4) Adaptation, and (5) Time and Task Management.

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The first theme emerged from the analysis presented the strategic use of both provided and additional resources by students to enhance their learning, comprehension, and academic performance. The second theme elaborated social and academic connections that students rely on to enhance their learning, overcome challenges, and achieve academic success. The third theme revolved on reaching out to classmates, family members, and professors for help. The fourth theme described approaches students take towards their education, where they take responsibility for their own learning process. The fourth theme were strategies and adjustments students make to optimize their learning conditions and overcome obstacles in their educational environment. The fifth theme explained the strategies students employ to efficiently manage their time and prioritize their academic responsibilities.

Resource Utilization

Utilizing Provided Materials. Effective use of provided materials is a crucial strategy for students to enhance their understanding and performance. In the pandemic, schools provide modules for students to read and study. Despite the challenges that the students encountered, they still make use of provided materials, modules, books, highlighting key terms, and reading assigned materials in advance.

P1 emphasized the importance of reading modules when internet connectivity was poor, stating, "When there is internet connectivity, and when the net is still weak, I read the modules provided. And that's also the explanation, so we also understand better with the help of the module." P6 discussed the proactive approach of advanced reading and addressing unfamiliar terms from provided modules, saying, "I read in advance the files provided. Then when there are unfamiliar words of my encounter, I tried to know the meaning, sir. So, I seem to understand something." Similarly, P7 integrated advanced reading, reviewing, and highlighting key terms during discussions, noting, "...during our online activities, I read the lessons in advance as well. I review and then I used what is in the examples as my basis...I also print in advanced all the learning materials. Then, it is what I use to follow the discussion, I also highlighted the material."

The narratives underscored the importance of utilizing provided materials effectively in an online learning environment. Strategies such as advanced reading, self-study, reviewing, and highlighting key terms can significantly enhance comprehension and engagement with the subject matter. These practices enable students to overcome challenges related to online learning and ensure a more productive educational experience. Research by Cajurao et al. (2023) underscores the effectiveness of utilizing printed and digital modules, particularly beneficial for students in rural areas with limited internet access. The study highlights how these methods have enabled students to navigate technical and non-technical challenges, ultimately contributing to improved learning outcomes.

Utilizing Additional Resources. In addition to using the provided materials, students often turn to external resources to supplement their learning. This includes watching YouTube videos, conducting online searches, and reviewing similar lessons. These additional resources help clarify concepts, provide alternative explanations, and offer practical problem-solving techniques that enhance their understanding.

P1 emphasized the necessity of conducting research to understand and apply mathematical formulas effectively during activities, stating, "When it comes to the formula, you really need to research, sir, when there are activities that are given." Similarly, P5 highlighted the importance of research in understanding and applying mathematical processes, saying, "If I can't understand it,

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I will research that process. Then, from there, I will start another problem so that I can assess it with the rest."

Many students, including P2, P3, P4, P6, P7, P8, P9, and P10, utilized YouTube and Google searches extensively. P2 mentioned using YouTube and Google searches to find sample problems and explanations, which aided in better understanding and practice. P3 relied on YouTube videos for learning problem-solving techniques, finding them helpful in grasping difficult concepts. P4 combined peer support with YouTube tutorials to reinforce learning, while P10 integrated peer interaction with YouTube videos to tackle challenging subjects. P6 found YouTube tutorials particularly useful for understanding statistics, suggesting that video explanations clarified complex topics effectively. P7 regularly turned to YouTube for tutorials when encountering difficult concepts, emphasizing the platform's reliability as a learning resource. P8 watched YouTube videos for simpler, more comprehensible explanations, enhancing the efficiency of the learning process. P9 utilized both books and YouTube for studying mathematics, combining traditional and digital resources for a comprehensive understanding.

The narratives highlight the importance of additional materials like YouTube videos and online searches in supporting students' learning. These resources provide alternative explanations and practical problem-solving techniques, enhancing students' understanding and helping them overcome challenges in their studies. In the context of online classes in the Philippines, there is a growing reliance on YouTube videos as supplementary learning tools, particularly in subjects like Mathematics. Research by Insorio & Macandog (2022) highlights how these videos provide clear explanations, concrete examples, and visual aids that facilitate a deeper comprehension of complex concepts. This has become especially valuable during the COVID-19 pandemic, when traditional face-to-face instruction may be limited.

Support Networks

Seeking Assistance. Students frequently seek help from classmates, family members, and professors to overcome challenges in their studies, particularly in an online learning environment. Students like P1, P2, P4, P7, and P10 shared how they ask for help from their classmates. They frequently consult classmates who are more adept in certain areas, sharing knowledge and clarifying doubts. P1 mentioned, "When I really can't find the symbols that need to be used, I just ask my friends to send them. Because we have a classmate, sir, who is good when it comes to symbols. We just ask him to send it, sir. We asked him to teach us where to look so that next time we won't disturb him again, sir." P2 stated simply, "I asked my classmates, sir, after the discussion." P4 extends help-seeking to math experts among peers, saying, "Classmates. But there are also times where I asked for help or enlightenment from other people, especially from the math wizards I know." P7 shared, "Sometimes I also ask my classmates on how it is done and then they can explain to me." P10 explained, "What I did was I asked help from my classmates. Sometimes, I asked my friend who is an electrical engineer to teach me how to solve it. Since we see each other every Sunday. And because of that I can somehow answer the activities."

Aside from the help of classmates, participants also sought help from family. P3 narrated the role of family support in academic pursuits. Utilizing resources like a sibling's book and seeking help from a parent for problem-solving can provide immediate assistance and understanding. "I asked for my sister's book. And then my father, I ask him to solve the problems that I can't solve." P3 narrated.

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P8 and P9 emphasized the importance of direct communication with professors. After all they are the ones with knowledge about the lessons discussed in class. P8 mentioned, "I just told our teacher that it is not possible in Moodle. Because that's what was suggested to us to use it." P9 added, "What I usually do is I contact my prof regarding that topic." - P9

The narratives demonstrate the multifaceted approach students take to seek assistance, involving classmates, family members, professors, and external networks. Additionally, findings from Bautista et al. (2021) emphasize the importance of leveraging social networks and external resources to address the diverse challenges encountered in online learning environments. These collaborative efforts underscore the resilience and adaptability of students in navigating the evolving landscape of digital education.

Collaborative Learning. Collaborative learning involves discussing lessons with classmates, participating in class discussions, and assisting peers. This approach helps students understand complex topics better by sharing knowledge and working through problems together. P1 mentioned, "When we don't understand the specific process, sir, we ask questions in the GC on how to come up with that answer." P9 explained, "So, what we did is we send our solutions to our GC and there are people who explain it. But for me, once I see the solution, I can get it right away." P10 added, "We just ask questions, studying together. Through video call, through chat, we study." P3 and P7 admitted their roles in guiding their peers without providing direct answers. P3 said, "It's like I just directed them on what to do. I don't give my answer in full." P7 mentioned, "When they don't know something in their calculus lecture, they ask me for help, Sir. So, because of that, it's like I'm retaining the lessons I'm studying." P4 emphasized the effectiveness of group studies and open forums: "I was able to communicate with my classmates and do group study, teach, as if we were an open forum on how we understood the certain topic. And then if some of us didn't understand, it was like we were teaching each other."

A common scenario where classmates collectively struggle with understanding a topic was shared by P6. The act of discussing and attempting to learn together helps in identifying gaps in knowledge and collectively seeking solutions, which can be more motivating than studying alone: "There were times when they discussed, sir, but at the same time, sir, they didn't understand either. So, we seem to be on the same page and we discussed to get to know it, sir."

The narratives demonstrate that collaborative learning is a crucial strategy for students, particularly in an online learning environment. By discussing lessons, guiding peers, engaging in group studies, and collectively tackling difficult concepts, students enhance their understanding and create a supportive learning community. In the Philippines, students frequently rely on their peers for support amidst the challenges posed by online education. Research by Sahib (2022) indicates that collaborative efforts with classmates play a crucial role in overcoming obstacles like unreliable internet connections, unclear instructions, and demanding coursework.

Self-directed Learning

Self-Study and Note-Taking. Self-study and note-taking are critical strategies that students use to enhance their understanding and retention of course material. By actively engaging with the content through personal study sessions and note-taking, students can better grasp complex concepts and retain information more effectively. P1 emphasized the importance of detailed note-taking during study sessions to create a reliable reference: "We are taking down notes on how to do it and so that at least, we won't forget it." P5 expressed determination in understanding challenging material independently: "It's like I did it myself. When I have a hard time, sir, it's like

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I keep on trying to understand it on my own." P7 described their process of breaking down and analyzing formulas to understand problem-solving methods: "I studied how they got the answer using the formula or how to solve the easy ways to get the answer." P8 highlighted the advantage of self-paced learning, enabling thorough understanding of math problems step by step: "I can do my own pacing to understand, step by step when it comes to math problems, sir."

The narratives demonstrate that self-study and note-taking are essential practices that help students to independently master their coursework. These strategies empower students to take control of their learning process, making them more self-reliant and capable of overcoming academic challenges. Research by Pineda and Javier (2023) on online self-regulated learning (SRL) strategies among college students in the Philippines corroborates these findings. The study emphasizes that employing SRL strategies, such as structured study environments, is crucial for navigating the complexities of online education.

Reviewing and Revisiting Materials. Reviewing and revisiting course materials, such as modules and recorded lectures, is a fundamental strategy for reinforcing learning and deepening understanding. P1 emphasized the importance of revisiting modules after live sessions to improve understanding: "After the live, I will go back to the module to understand it better." P5 found benefit in repeatedly watching recorded lectures to aid comprehension: "It turned out okay because of watching the recorded lessons over and over again." P7 engaged in revisiting online discussions posted on course pages to achieve mastery: "When the discussions are posted on the page, I watch it repeatedly until I learn it."

The narratives illustrate that reviewing and revisiting materials are effective strategies for enhancing learning outcomes. Whether through modules, recorded lectures, or online discussions, these practices allow students to reinforce their understanding, clarify doubts, and consolidate knowledge. In one university there is an implementation of Project OSO, featuring online, shareable, and offline video lectures, has proven successful in enhancing students' learning outcomes. Specifically, in subjects such as mathematics, this initiative has addressed gaps in untaught competencies (BatiLantes, 2023).

Adaptation

Technology and Connectivity. Students often face challenges related to gadgets, internet connectivity, and access to necessary resources. P1 highlighted the adaptability in addressing connectivity issues by switching to mobile data when WiFi is unreliable: "If it's really not possible with Wi-Fi, I buy load so that I can at least used data." P2 demonstrated an effort to improve connectivity by searching for better signal reception outside their home. This initiative reflects the challenges many students face in ensuring stable internet access: "I will go outside the house to look for a signal." P4 shared the importance of using efficient devices, such as laptops, for enhanced visual clarity during online learning sessions: "I tried to use my laptop which is more efficient and more effective in seeing the visuals."

The narratives above show the critical role of technology and connectivity in supporting online learning experiences. Students' proactive approaches, such as switching to data when WiFi is unreliable, seeking better signal reception, and optimizing device efficiency, demonstrate their resilience in overcoming technological challenges. Research by Tupas et al. (2023) underscores the significance of technology and connectivity in improving learning outcomes. The study advocates for enhanced internet access within educational institutions to support seamless digital learning experiences.

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Adapting Study Environments. Creating an ideal study environment is crucial for effective learning, especially in the context of online education where distractions can significantly impact concentration. P1 emphasized the importance of physical isolation and sound management to minimize external distractions: “The windows, the door, I closed them, Sir, so that nothing can be heard. And then I amplified the meeting and I use ear phones.” P5 described the strategy of isolating oneself to prevent distractions, indicating a deliberate effort to create a focused study environment: “Isolate, sir. So that you are no longer distracted.” P5 further elaborated on actively searching for conducive study spaces where they can effectively focus on lectures: “I also looked for a place where I could focus on the lecture on a timely manner.”

Creating an adapted study environment involves strategic measures to minimize distractions and optimize focus during online learning. Students like P1 and P5 demonstrate resourcefulness by closing doors and windows, managing sound levels, using earphones, and seeking out quiet study spaces. Research contributions by Atoy et al. (2020), Del Mundo et al. (2022), and Sahib (2022) emphasize the importance of these strategies in fostering a conducive learning environment. By integrating these measures, educators and students can enhance engagement, productivity, and overall success in online learning settings, ensuring a more fulfilling educational experience.

Time and Task Management

Time Management and Avoiding Distractions. Effective time and task management are essential skills for students navigating online learning environments. P1 emphasized setting clear deadlines and adhering to a structured schedule to ensure timely completion of tasks was the strategy: “Once the activity is given, sir, you need to do something. You need to solve it. For example, sir, now, you should set time. For me, I set time. So, on this particular time you’re done with this and that so that in 2 days before the deadline, you can already submit. You have nothing to think about.” P2 discussed in the interview the practice of avoiding procrastination by completing tasks promptly once assigned: “When something is given to me, if I can finish it by some time, I won’t do it on the next day, it’s like if I finish it the next day... Oh, I’m resting for a while.” P7 highlighted the strategy of setting daily goals and schedules to manage academic tasks efficiently: “So, you should have a target goal for each day. What I’m doing is I’m setting my schedule such that on this particular day, I’m done with everything.” Meanwhile, P9 shared that studying late at night as a strategy to capitalize on quiet hours for increased concentration and focus:”What I did was I do my modules at night. Sometimes I can reach up to 3am just to finish my activities. At that time, there was silence.” - P9

Effective time and task management in online learning environments involve setting clear deadlines, avoiding procrastination, setting daily goals, and leveraging optimal study hours like late nights for focused study sessions. These strategies, as exemplified by P1, P2, P7, and P9, enable students to maintain productivity, manage their workload efficiently, and achieve academic success amidst the challenges of online education. Additionally, creating a conducive study environment, being prepared with necessary materials, practicing effective time management, and utilizing search engines for supplementary resources are essential strategies emphasized in research by Del Mundo et al. (2022) and Radin & Shlat (2021). These approaches help students navigate the complexities of online learning, enhance their understanding of course material, and maintain consistent academic progress.

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III. Interventions to Improve Mathematics Education During Pandemic

The COVID-19 pandemic disrupted education systems globally, forcing educators to quickly switch and adapt to remote learning. In learning Mathematics, the sudden transition to a new normal brought challenges and opportunities. To address these issues effectively, a series of interventions were formulated, grounded in a comprehensive analysis of both students' expectations and faculty observations. By interviewing 10 students, the researcher identified their struggles and expectations to resolve the problems, while three faculty insights provided a broader perspective on challenges and potential solutions. Using deliberate data analysis, the researcher identified four interventions that were well-aligned with the actual needs and experiences of the students and faculties.

Teacher Training and Professional Development

One of the participants observed that there are professors who are new to using digital platforms who struggle to manage and troubleshoot online learning tools, leading to issues such as denied access and missed submissions. 8 observed that some professors struggle with digital platforms, leading to issues such as denied access and missed submissions. Ma'am U highlighted the initial challenges during the pandemic, with both students and teachers struggling to adapt to online platforms and unstable internet connections. She also emphasized the need for thorough training on using CSU-LENS due to difficulties in sending exams and quizzes, particularly those containing equations.

Supporting this, Sir X and Sir Y emphasized the need for teacher training on technology. Ma'am V mentioned that the university has already conducted capacity-building training for faculty on transitioning to online learning.

P10 expressed a desire for more detailed explanations on problem-solving and increased student engagement, suggesting proper training for professors. In response, Sir Y suggested techniques like calling student names multiple times to improve engagement.

Teacher training and professional development are essential in modern education, especially for integrating technology effectively and enhancing student engagement. This intervention focuses on equipping educators with up-to-date technological skills and effective teaching strategies through continuous training programs.

Additional Educational Resources and Activities

Participants noted the absence of mathematics-related seminars or webinars, highlighting a significant gap in additional educational resources. P4 mentioned that the campus primarily conducted seminars focused on mental health rather than on learning math: "The campus, they didn't really have any seminars or webinars conducted. But it's mostly for mental health. But not on learning math." Similarly, P8 observed that the events were more about coping strategies and study tips rather than specific academic content: "Maybe sir, those events are like seminars to cope or study tips. The seminars they gave to students."

When asked about overcoming struggles with learning Mathematics, P7 and P8 suggested more math-related activities and resources. P7 proposed increasing the number of activities related to math: "I suggest maybe more activities that are also related to math... team buildings and the likes. Or just like the per station, sir, where students will solve rubrics or maybe first to solve math and the like." P8 emphasized the need for more video lectures to allow students to review and

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develop mastery of the topics: "Providing more video lectures, sir, so that you can go over, you can review, to develop more mastery of the topics in that subject, sir."

In response, Sir X highlighted the importance of lecture videos, especially for students with unstable internet connections during live discussions. While Ma'am W pointed out the necessity for workbooks, modules, and interactive technological tools to aid in math education. Additionally, Ma'am V stressed the importance of sustaining adequate facilities and resources for online learning, irrespective of the pandemic.

By incorporating a variety of additional materials, such as video lectures, workbooks, and interactive tools, educators can cater to diverse learning styles and reinforce classroom instruction. This intervention will ensure that both teachers and students have access to the necessary resources and activities for effective online learning. It includes the provision of reliable internet access, appropriate devices, interactive technological tools, and well-prepared workbooks or modules.

Student Engagement and Feedback

Active student engagement and timely feedback are fundamental to effective learning. Implementing systems to monitor learning progress and provide constructive feedback can guide students towards improvement and foster a deeper connection with the material.

The participants noticed a lack of engagement in online classes, which led to suggestions for improvement. P9 suggested that teachers should encourage more engagement during discussions: "Maybe that time, the teachers must allow engagement from the students because mostly during our discussion that time our prof just reads or explains those subjects and he no longer interacts with other students, the rest of the class." Similarly, P10 hoped for more detailed discussions on solving math problems and increased student interaction: "In the lecture, in the video presentation, sir, there should be step by step process that explains how to solve that. Also, in the online platform, there is like a recitation where there is a student solving the problem that's being explained online. But our prof is doing during that time, sir." P9 also proposed the use of polls to track student learning, ask questions, and provide feedback: "Even if it's just a poll or like a google form where we can ask questions regarding certain topics that we don't understand." They further expressed the desire for a system to monitor student learning and provide constructive feedback: "One of the things I would like to hear that time the professors asked if we get the topic. Or if we know how to get those solutions and there are some professors who do it that way, allowing the students themselves to explain their own solution, but there are professors who don't do it that way."

In response, Sir X explained that he provides feedback to struggling students but finds it challenging to reach those who show a lack of interest in their academic performance. Sir Y suggested maximizing different modalities to encourage student engagement, such as using forum features on their platform.

Participants highlighted the need for more interactive discussions, detailed explanations, and mechanisms to track and address student understanding. By incorporating polls, recitations, and varied learning modalities, educators can foster a more interactive and supportive learning atmosphere. These interventions not only ensure that students are actively involved in their education but also provide the necessary feedback to guide their improvement. This intervention focuses on ensuring that both teachers and students have access to the necessary resources and facilities for effective online learning. It includes the provision of reliable internet access, appropriate devices, interactive technological tools, and well-prepared workbooks or modules.

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Improve Teaching Style and Methods

Several participants mentioned in the interview their expectations and some possible intervention to improve Mathematics education during the pandemic.

P1 compared the teaching style of one of his professors and expressed a desire for other professors to adopt the same method: "The teacher has a board and then computes there so we can see the process on how it is done. It seems like that is what is missing from other professor sir, I wish they had written it like that so my classmates could understand it. Because not all of us are quick to pick up on how it is done." P1 also suggested a system similar to paired learning or peer teaching, where students who understand the lessons well can help those who are struggling: "Maybe there should be something called paired learning, like that or like peer teaching. For example, those who don't understand or those who have more difficulty at that time, I wish the prof was like that, I wish he was told or like they were the ones who focused more attention."

In response, Sir X stated that he incorporated peer and collaborative activities in his classes, particularly group work, to reduce the workload on teachers and allow students to monitor each other's progress: "I'm doing the peer and collaborative activities in my classes specially when that require group activities. This lessens the burden of the teacher and at the same time since it is online, we can't monitor all the activities of the students, so having a group make way to other students to check each other activity."

The narratives from the student participants are a call for interventions to prevent further problems and enhance the learning experience, particularly in Mathematics. By adopting more effective and inclusive teaching styles, prioritizing comprehensive understanding, and providing accessible resources like recorded lectures, educators can better support all students, especially those struggling with traditional approaches.

CONCLUSION

During the COVID-19 pandemic, students faced significant challenges in online mathematics education, primarily due to technological and connectivity issues, distractions in their study environments, and difficulties with digital literacy and online platforms. Adaptation strategies included switching to mobile data, seeking better signal areas, and creating quieter study spaces. Students relied on self-directed learning methods such as detailed note-taking and reviewing recorded lectures. Despite their efforts, many experienced frustration, loss of motivation, and increased pressure from the lack of immediate support. Additionally, barriers to effective communication and collaboration with peers and teachers further hindered their learning experience. Significant challenges such as connectivity issues and limited access to devices, which students managed by using mobile data and finding better signal reception. Creating an ideal study environment by isolating themselves, managing noise levels, and seeking quiet spaces was crucial. Effective time management strategies included setting structured schedules, avoiding procrastination, and utilizing quiet hours. Support from peers, family, and professors played a vital role, while challenges with digital literacy affected both students and teachers, impacting full engagement with online learning platforms.

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