Flexible Teaching-Learning Modality in Mathematics Education of a State University in West Philippines

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Abstract: In response to paradigm shifts in education, teacher education institutions have increasingly adopted flexible learning modalities such as online courses, blended learning approaches, and personalized instruction to meet the diverse needs of students and prepare educators for the demands of modern classrooms. This study used a mixed-method research design to gain a comprehensive understanding of the flexible teaching and learning modalities it brought to mathematics teacher educators (MTEs) and learners in a state university in West Philippines. Since ethical considerations preclude random sampling, the study comprised nonrandom participants using purposive sampling, where 189 learners were surveyed, and six MTEs and 16 learners were interviewed. A researcher-made interview guide was prepared to describe the flexible teaching and learning modalities and opportunities of the MTEs. Also, a researcher-made questionnaire was used to describe the learners' general assessment of the flexible teaching and learning modalities in mathematics education. Quantitative data were gathered online, while qualitative data were gathered through interviews. Results showed that flexible teaching-learning approaches have implications for education, overcoming barriers, and promoting engagement. The findings highlight the importance of technology integration, inclusive assessment modalities, infrastructure support, and professional development opportunities in enhancing the quality and accessibility of flexible teaching and learning, ultimately leading to inclusive educational environments. Therefore, the educational institution must adopt flexible instructional modalities, emphasize diverse assessment methods, and personalize the learning experience by integrating online platforms and various assessments for effective mathematics instruction.

Keywords: COVID-19 pandemic, flexible instruction, new normal, mathematics education

INTRODUCTION

The coronavirus disease (COVID-19) has prompted global challenges and adjustments in the education sector in that it halted the operation of educational institutions (OECD, 2020) and caused a crucial disruption in the educational system (Dayagbil et al., 2021; Fuchs & Tsaganea, 2020), where no one knows when it will end (Tria, 2020). In the Philippines, particularly in higher education institutions (HEIs), the COVID-19 pandemic replaced the traditional face-to-face classroom with flexible teaching and learning. These paradigm shifts in the educational system posed challenges for both students and teachers (Lapitan et al., 2021; Zheng et al., 2020), including parents and school administrators. Nevertheless, changes in the educational system do not hamper quality education. To continue the delivery of instruction, the Commission on Higher Education

(CHED, 2020) promulgated the guidelines on flexible teaching and learning implemented by public and private HEIs.

HEIs offering teacher education programs faced the new norm and adopted flexible teaching and learning approaches in preparing future teachers. Cassidy et al. (2016) defined flexible teaching and learning as a pedagogical approach that allows place, time, and audience flexibility but does not focus on technology utilization. Flexibility in time is considered the most crucial aspect of flexible teaching and learning for students' education (Dimarucot et al., 2021). Flexible teaching and learning have always been the most appropriate approach to broadening access to education. Accordingly, HEIs are prompted to redesign the educational system using information and communications technology (ICT) and the available alternative delivery modes of instruction (Pawilen, 2021). Malipot (2021) echoed the Commission on Higher Education's (CHED) view that traditional face-to-face learning may no longer be appropriate in HEIs, as it advocated for implementing flexible teaching and learning in the school years that followed. Like traditional face-to-face, flexible teaching and learning have merits and limitations for teacher education institutions (TEIs).

TEIs were confronted with the challenges of flexible teaching and learning. Teacher educators (Gayon & Tan, 2021; Jones & Kessler, 2020) and learners (Gocotano et al., 2021; Ozudogru, 2021) experienced difficulties during the pandemic period, especially during the virtual classroom (Konuk, 2021). Nevertheless, flexible teaching and learning could be an agent in promoting a learner-centered environment as TEIs deviate from traditional to innovative pedagogical approaches; with the uncertainty that TEIs experience, teacher educators and preservice teachers continue embracing flexible teaching and learning. This study is necessary to determine the modalities derived from teacher educators and learners in these challenging times. Besides, this study agreed and argued with several studies for flexible teaching and learning in TEIs. Furthermore, the study proposed an action plan to enhance teacher educators' flexible teaching and learning modalities that can be used by the TEI involved, which can be extended to other TEIs. The unanticipated transition to flexible teaching and learning has brought challenges and opportunities (Carrillo & Flores, 2020). While there is an extensive study on flexible teaching and learning among HEIs, how TEIs engaged in the sudden shift to flexible teaching and learning is limited. With the COVID-19 pandemic, this study sought to establish the modalities the MTEs and learners employed in crafting a more relevant, flexible teaching and learning environment.

Flexible teaching and learning options may include digital and non-digital technologies, face-to-face or in-person learning, out-of-classroom learning modes, or a combination of these delivery modes (CHED, 2020). Factors such as internet access, availability of devices, and strengthening online learning platforms are crucial considerations when designing a flexible teaching and learning environment. Teacher educators and learners must be technologically literate and innovative (Gocotano et al., 2021), as technological education is necessary for meeting emerging standards and challenges (Levinson, 2020). Flexible teaching and learning in TEIs address the gaps between teaching and learning in the new normal (Jigyasu et al., 2021). It refers to educational techniques and systems that offer learners enhanced choice, convenience, and personalization (Khan, 2019). Various learning modes are employed, such as full-time online, blended learning, flipped classroom, and distance learning (Bates, 2019). Flexible teaching and learning helped

learners manage their activities according to their needs and interests (Urgel, 2020). TEIs and MTEs must respond promptly to the shift to flexible teaching and learning by creating an atmosphere that supports preservice teachers (Gayon & Tan, 2021). They must regularly revise their faculty development plans to enhance performance and promote social issue participation and sensitivity (Pawilen, 2021). ICT literacy is, thus, critical for MTEs and learners. MTEs can provide course packages for preservice teachers, whether online or offline (Gayon & Tan, 2021). Accordingly, learners must develop self-directed and self-regulated learning skills in a flexible teaching and learning environment.

Theoretical Framework

The study's theoretical framework is built on the Framework for Capacity Building of Teacher Education Institutions, the Asynchronous Course Delivery (ACCORD) Framework, and the Guidelines on Flexible Learning Implementation by the Commission on Higher Education. The Framework for Capacity Building of Teacher Education Institutions provides guides for improving teacher preparation courses through six strategic dimensions. These dimensions focus on vision and philosophy, program development, professional learning, ICT integration, partnerships, and research and evaluation (Lim et al., 2011). The ACCORD Framework outlines a systematic approach to delivering high-quality online courses that allow for asynchronous learning (Abisado et al., 2020). It includes course design, management, assessment, student support, instructional technology, and instructor support. Meanwhile, the Guidelines on Flexible Learning Implementation guide HEIs to implement flexible teaching and learning programs (Commission on Higher Education, 2020). These guidelines comprise course design, faculty development, assessment, infrastructure and technical support, and student services. Considering these frameworks, the study explored flexible teaching and learning modalities for educators and learners. It focused on curriculum, assessment, professional development, ICT integration, instructional technology, instructor support, and student services. The study sought to contribute to improving teacher education programs and effectively implementing flexible teaching and learning in response to evolving educational needs and challenges.

Conceptual and Analytical Framework

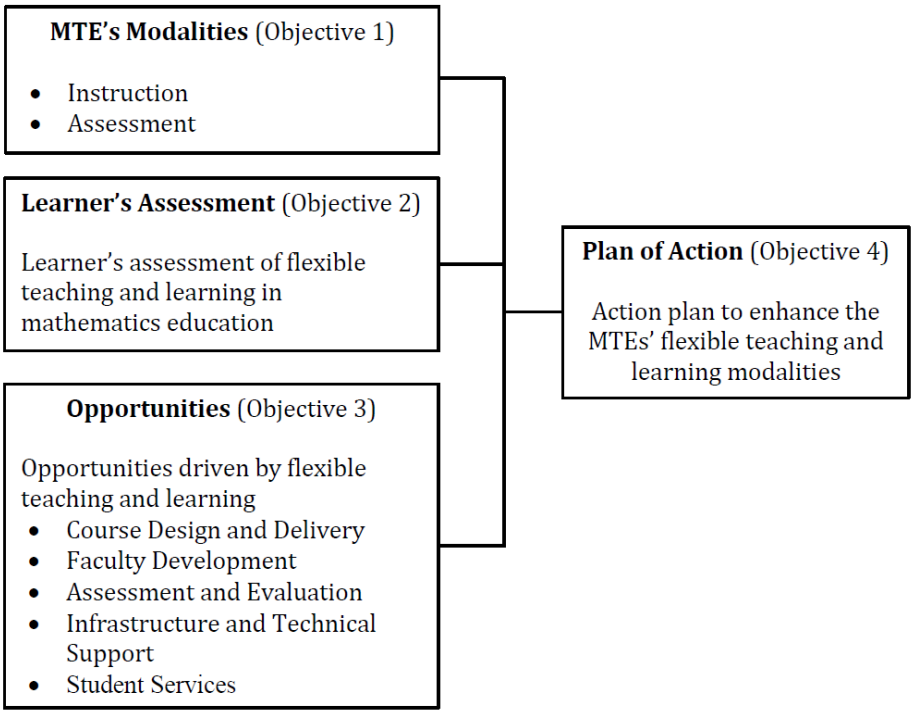
Figure 1 (see next page) illustrates the research paradigm focused on flexible teaching and learning in mathematics education. As portrayed in the framework, learners' general evaluation of flexible teaching and learning modalities in mathematics education was established through the quantitative phase (Objective 2). Meanwhile, the qualitative phase described the MTEs' modalities along instruction and assessment (Objective 1) and opportunities driven by flexible teaching and learning for MTEs and learners along course design and delivery, faculty development, assessment and evaluation, infrastructure and technical support, and student services (Objective 3). The findings from Objectives 1, 2, and 3 formed the foundation for creating an action plan to improve the flexible teaching and learning modalities of MTEs (Objective 4).

Research Objectives

This study determined the flexible teaching and learning modalities among MTEs and learners in a state university in West Philippines. Specifically, it aimed to:

1. determine the flexible teaching and learning modalities employed by the MTEs in terms of instruction and assessment;

2. determine the learners' general assessment of the flexible teaching and learning modalities in Math Education;
3. determine the opportunities provided when implementing flexible teaching and learning in terms of course design and delivery, faculty development, assessment and evaluation, infrastructure and technical support, and student services; and
4. prepare a plan of action to enhance the flexible teaching and learning modalities of MTEs.



METHODOLOGY

Research Design

A mixed-method research design, compounding quantitative and qualitative research methods (Creswell et al., 2003), was employed to understand the flexible teaching and learning implementation in mathematics education. This research design helped to provide insights into the effectiveness of flexible teaching and learning in mathematics education and guide future educational policy and practice. The quantitative phase determined the learners' general assessment of flexible teaching and learning modalities in mathematics education. On the other hand, the qualitative phase described the MTEs' modalities and the MTEs' and learners' opportunities driven by flexible teaching and learning. Quantitative and qualitative results served as a basis for crafting an action plan to enhance the flexible teaching and learning modalities of MTEs.

Research Participants

The study's respondents were mathematics teacher educators (MTEs), core faculty handling math subjects, and BSEd-Math and BEEd third-year and fourth-year students (learners) in a state university in West Philippines. These participants experienced flexible teaching and learning implemented from the first semester of SY 2020-2021 to SY 2022-2023. An invitation letter indicating informed consent and voluntary participation was sent to the participants. The quantitative study utilized nonrandom sampling. This sampling refers to selecting individuals from a population in a nonrandom manner. A sample of 189 learners participated in the quantitative study to determine their general assessment of the flexible teaching and learning modalities in mathematics education, along with online and modular teaching and learning. For the qualitative study, purposive sampling was employed since these participants were held to share their rich experiences in flexible teaching and learning challenges posed by the COVID-19 pandemic, where modalities and opportunities were derived. Four MTEs were interviewed about their flexible teaching and learning modalities regarding instruction and assessment. Meanwhile, 16 learners and six MTEs participated in describing the opportunities provided to MTEs and learners during the implementation of flexible teaching and learning.

Research Instrument

A researcher-made interview guide was prepared to describe the flexible teaching and learning modalities employed by the MTEs regarding instruction and assessment. The interview questions on instruction modalities asked about teaching methods used in flexible learning, the development of instructional materials, flexible course policies, consultation hours, and other instructional modalities implemented. On the other hand, the interview questions on assessment modalities looked into assessment methods, including written works and performance tasks, scoring rubrics, and major exams. It also asked about the validity of the assessment tools.

A researcher-made questionnaire based on a four-point Likert scale was used to describe the learners' general assessment of the flexible teaching and learning modalities in mathematics education, along with online and modular teaching and learning. The statements for online teaching and learning described the benefits of flexible teaching and learning through online options, including convenience, access to course materials and resources, interaction with professors and peers, and better work-life balance. Meanwhile, the statements for modular teaching and learning described the benefits of flexible teaching and learning through printed and electronic modules, including flexibility, well-designed materials with assessments, independent study, and a better understanding of course material. The following qualitative descriptions were employed: 4 = Strongly Agree; 3 = Agree; 2 = Disagree; and 1 = Strongly Disagree. The instrument was pilot-tested on non-participants and tested with validity and reliability. The instrument used in the study demonstrated high internal consistency with Cronbach's alpha coefficients of 0.879 (online) and 0.929 (modular), indicating that the instrument reliably measures the learners' assessment.

Finally, self-made semi-structured interview questions guided the researcher in describing the opportunities provided to MTEs and learners during the implementation of flexible teaching and learning in terms of course design and delivery, student services, faculty development, assessment and evaluation, and infrastructure and technical support, based on CHED Memorandum Order no.

4, series of 2020. This instrument was submitted to three experts, a mathematics professor, a teacher educator, and a qualitative researcher, for validation to ensure its relevance for the study.

Data Gathering Procedure

The Saint Mary's University Research Ethics Board approved the protocol at Saint Mary's University, Bayombong, Nueva Vizcaya, Philippines (Code: 2Sem 203 309). Ethical factors such as conflict of interest, privacy confidentiality and data protection, risk/benefit ratio, informed consent, and terms of reference were considered during the evaluation process. Other than the approval from the University President through the College Dean of the research locale, informed consent from the participants was secured before gathering the data. The participants completed an informed consent form. A Google Form was utilized where the participants read the content and indicated their consent by ticking the box at the end of the form. After their consent, they were directed to another link for data gathering. Participants who declined had to indicate their reasons before submitting the form.

The researcher gathered data about the flexible teaching and learning modalities employed by the MTEs regarding instruction and assessment through face-to-face focus group discussions (FGD) to answer the first objective. For the second objective, a questionnaire collected data on the learners' general assessment of the flexible teaching and learning modalities in mathematics education. The questionnaire was translated into a Google Form to reach the target participants easily. Finally, for the third objective, virtual and face-to-face individual interviews were used to collect data describing the opportunities provided to MTEs and learners while implementing flexible teaching and learning.

The virtual interview was conducted through Google Meet, ensuring participants had the necessary devices and reliable access to the internet to participate effectively. Participants who did not attend face-to-face interviews or FGDs were provided free load cards, as those who chose virtual interviews or FGDs. The conversations from the interviews or FGD were audio-recorded with the participant's permission. Participants were encouraged to tell their stories and answer the questions in English or Filipino. A mobile phone recorded and replayed the conversations, aiding in data transcription.

Treatment of Data

For the first and third objectives, the qualitative data collected were evaluated using an inductive approach. The inductive analysis followed the three-step guide: Encoding verbatim, coding and deriving codes, and general code development. Transcripts from the interview and FGD were encoded verbatim. Responses in Tagalog were translated into English. Then, codes were derived from the data encoded, reflecting the patterns from the participant's narratives. Finally, general codes emerging from the codes/patterns were obtained and reported, answering the flexible teaching and learning modalities. Concerning the second objective, the quantitative data about the participants' flexible teaching and learning assessment were analyzed with mean and standard deviation descriptives. The following qualitative descriptions were employed: 3.50-4.00 = Strongly Agree; 2.50-3.49 = Agree; 1.50-2.49 = Disagree; and 1.00-1.49 = Strong Disagree.

RESULTS

Flexible Teaching and Learning Modalities Employed by the MTEs

The findings from the study highlight the flexible teaching and learning modalities employed by mathematics teacher educators (MTEs).

Instruction. MTEs utilized a combination of modular instruction and online learning. [*We utilize a combination of modular instruction and online learning, sometimes conducted in synchronous and asynchronous formats. It can be challenging since not everyone has access to the internet. (Teacher Bravo)*]. Modular instruction benefited learners without internet access, allowing them to continue learning offline [*Modular instruction only because some students do not have internet connectivity. Even though they have an online presence, we use group chat to send their modules and reminders, and I address their questions through group chat or private messages. The module itself is detailed, with lectures and exercises. I prefer not to conduct online classes with one or two students missing. Their reason is valid since they do not have internet connectivity, so I cannot assure the quality of teaching. (Teacher Alpha)*]. Online components such as synchronous discussions and asynchronous tasks were also integrated to enhance engagement and accessibility [*I conducted my classes online for Assessment and Evaluation in Mathematics and Research in Mathematics. I used Google Meet synchronously for discussions, while tasks were assigned asynchronously through Google Classroom. I provided feedback on students' outputs directly on Google Classroom. Online consultations were conducted through the group chat. (Teacher Delta)*]. The MTEs emphasized consultation, support, monitoring, and feedback, and flexible classroom policies to accommodate learners' needs and promote effective learning [*I do not have designated consultation hours, but I told them they could contact me anytime they have questions, and I will respond to them through private messaging. I encourage them to post their questions in the group chat because others may share them. (Teacher Alpha)*]. Besides, modular learning was found to promote personalized instruction and self-learning [*But the great thing about modular learning is that it promotes self-learning, which enables personalized instruction tailored to each student's learning requirements and preferences. (Teacher Foxtrot)*].

Assessment. The MTEs employed both formative and summative assessment methods. Formative assessments included exercises, pre-tests, post-tests, activity sheets, and problem sets [*We provide activity sheets and problem sets. They have weekly tasks to assess their readiness for the next lesson. (Teacher Bravo)*]. In contrast, summative assessments comprised major exams and performance tasks [*We have major exams like midterm and final exams and performance tasks like real-world problem-solving tasks and group projects to enhance their critical thinking, creativity, and collaboration. (Teacher Echo)*]. The MTEs ensured the validity and fairness of assessments by aligning them with the course syllabus and using rubrics and a table of specifications [*We have a rating scale for each problem-solving activity. We also have a Table of Specifications for major* exams (Teacher Alpha)]. They also provided timely feedback to learners, monitored their progress, and engaged in open forums to address their concerns [*I provide feedback and timely checking of their school tasks in specific subjects. I also encourage them regarding academic integrity. (Teacher Charlie)*].

Learners' General Assessment of the Flexible Teaching and Learning Modalities in Math Education

The findings from the learners' assessment of flexible teaching and learning modalities in math education denote that learners agree overall with implementing these modalities.

Online Instruction. In the case of online instruction (Table 1), learners appreciated the freedom to learn from anywhere and at any time through synchronous and asynchronous options (Mean = 3.34, SD = 0.63). They found the integration of online learning into the course syllabus and the orientation provided to be beneficial.

Indicators	Mean	SD	QD
1. Flexible teaching and learning allowed me to have the freedom to learn from anywhere and at any time, as it offered both online synchronous and asynchronous options.	3.46	0.56	Agree
2. This learning mode was integrated into the course syllabus, and we were thoroughly oriented about its usage.	3.42	0.57	Agree
3. The online classes were conducted using popular teleconferencing tools, and I could participate in them regardless of location or device.	3.32	0.69	Agree
4. This mode provided me with the convenience and flexibility to join classes from home.	3.38	0.62	Agree
5. My professors were available for online academic advising, feedback, and consultation, which helped me to stay on track with my studies.	3.22	0.67	Agree
6. Assessments were assigned or administered using tools like Google Classroom and Google Forms, making monitoring my performance and progress easy.	3.46	0.58	Agree
7. I could connect with my professors and classmates online, allowing me to interact and collaborate with my peers, further enhancing my learning experience.	3.33	0.65	Agree
8. Online platforms allow access to course materials and resources, making it easy for me to review and revisit course content.	3.36	0.63	Agree
9. This learning mode provided me with a better work-life balance, as I could attend classes and complete assignments at a pace that suited my lifestyle.	3.25	0.65	Agree
10. Overall, flexible teaching and learning via online options proved to be an effective and convenient mode of education for me.	3.17	0.70	Agree
Mean	**3.34**	**0.63**	**Agree**

Table 1. Learners' general assessment of the flexible teaching and learning modalities in math education and online instruction. (Note: 3.50-4.00 = Strongly Agree, 2.50-3.49 = Agree, 1.50-2.49 = Disagree, 1.00-1.49 = Strong Disagree; SD = Standard Deviation, QD = Qualitative Description)

Modular Instruction. Similarly, in the case of modular instruction (Table 2), learners generally agreed with the flexible modalities employed (Mean = 3.37, SD = 0.59). They acknowledged the inclusion of printed and electronic modules in the course syllabus and were well-oriented about this learning mode.

Indicators	Mean	SD	QD
1. Flexible teaching and learning included printed and electronic modules in the course syllabus.	3.44	0.56	Agree
2. We were thoroughly oriented about this learning mode and its implementation.	3.37	0.59	Agree
3. The printed modules were accessible at the college or designated distribution areas, while the electronic modules were easily accessible through platforms such as Google Classroom, Messenger, or email.	3.41	0.60	Agree

4. Instructional modules were provided at the start of the semester and were constantly updated throughout the course.	3.35	0.59	Agree
5. Modular learning allowed me to pace and schedule my personal and academic tasks, as I could study at my own pace and schedule.	3.39	0.59	Agree
6. The modules were well-designed, and the discussions, illustrations, and examples helped me enhance my understanding of the course material.	3.32	0.61	Agree
7. The modules indicated assessments, including pre-and post-tests, exercises, and activities, which allowed me to assess my learning and track my progress.	3.48	0.54	Agree
8. The modules were designed for independent study, allowing me to take ownership of my learning and become an active participant in my education.	3.33	0.58	Agree
9. Modular learning allowed me to better understand the course material, as I could revisit the modules at any time and focus on the areas I needed to improve.	3.29	0.61	Agree
10. Overall, flexible teaching and learning through printed and electronic modules proved to be an effective and convenient mode of education, providing me with the necessary resources and support to succeed in my studies.	3.32	0.62	Agree
Overall	**3.37**	**0.59**	**Agree**

Table 2. Learners generally assess the flexible teaching and learning modalities in math education along with modular instruction. (Note: 3.50-4.00 = Strongly Agree, 2.50-3.49 = Agree, 1.50-2.49 = Disagree, 1.00-1.49 = Strong Disagree; SD = Standard Deviation; QD = Qualitative Description)

Opportunities Provided during the Implementation of Flexible Teaching and Learning

Implementing flexible teaching and learning has provided various opportunities for teachers and learners, as revealed through interviews and focus group discussions.

Course Design and Delivery. The MTEs had the opportunity to integrate technology into their teaching, using software applications and digital platforms to enhance engagement and cater to different learning styles [*"I used software applications in my lessons, such as GeoGebra and Desmos, for graphing purposes." (Teacher Charlie)*]. They also emphasized responsiveness to learners' needs, providing detailed modules and offering various learning options such as online and modular learning, e.g., *"I make sure that the module is detailed with enough examples, step by step, especially since some cannot access the internet." (Teacher Alpha).* Additionally, teachers promoted self-learning and independent exploration by providing comprehensive materials and resources, allowing students to learn independently, e.g., *"They have learned through their independent learning and self-learning, which has made the process engaging and not boring." (Teacher Bravo).*

Faculty Development. The MTEs had the opportunity to expand their technological and digital literacy through training programs and webinars [*"Because of webinars, my digital skills and computer literacy have improved." (Teacher Charlie)*]. They could learn from experts worldwide through virtual conferences using platforms like Zoom and Google Meet [*"Through Zoom, numerous webinars became popular. Unlike before, when the university would select whom to send to seminars during face-to-face sessions, now anyone willing can attend through Zoom or Google Meet." (Teacher Alpha)*]. Online courses and advanced studies were also accessible [*"There are many opportunities. I was able to enroll in graduate school. I also took free courses through Coursera and Coursebank." (Teacher Delta)*], allowing teachers to pursue further education and enhance their qualifications.

Assessment and Evaluation. During flexible teaching and learning, the MTEs have provided flexibility in assessment, allowing students to access exams and evaluations from anywhere with an internet connection [*"I became flexible because the students and their learning were affected. Exams and performance tasks were still required, but I always made sure that no one would be left behind in the class." (Teacher Delta)*]. Authentic assessment methods, such as real-world problem-solving activities and alternative evaluation forms, were incorporated to promote creativity and critical thinking skills [*"I included other forms of assessment, such as projects, presentations, case studies, portfolios, group work, and online conversations, rather than depending simply on conventional tests or quizzes." (Teacher Echo)*]. Technology played a role in efficient evaluation, with online platforms like Google Classroom enabling automated assessment and streamlined feedback processes [*"I have used various online platforms for my assessments. These digital platforms provide individualized feedback, like Google Forms, which has helped us promptly address our learners' needs and provide personalized guidance for improvement." (Teacher Foxtrot)*].

Infrastructure and Technical Support. The MTEs benefited from technological support, including free Wi-Fi, laptops, and other resources provided by their institutions [*"The university provided free Wi-Fi, load card, and laptops to connect with our learners." (Teacher Bravo)*]. Access to digital resources was also facilitated, eliminating the need for teachers to invest in their equipment [*"The university installed free Wi-Fi in each college and provided laptops. As teachers, we did not need to invest as the university provided the necessary resources for flexible learning and teaching. Unlike in a traditional setting, where we had to use our laptops." (Teacher Alpha)*]. Teachers could organize course materials, track student progress, and communicate effectively through digital platforms, ensuring efficient learning process management [*"I can effectively organize course materials, track student progress, give timely comments, and encourage involvement using digital platforms and tools. Using these skills, I can spot learning gaps and fill them, communicate meaningfully with students, and modify lessons to fit each student's requirements." (Teacher Foxtrot)*].

Student Services. During flexible teaching and learning, students were given various opportunities for student services, as reflected by the CommunicaToAL: Communication Tools and Applications on Learning and SuppoSe: Support to Students. Communication tools and applications play a crucial role in facilitating learning and connectivity. Students expressed their appreciation for platforms like Google Classroom, Zoom, Google Meet, Messenger, and Gmail, which allowed them to continue their studies and gain knowledge even during the pandemic [*"Flexible teaching and learning made me access support services, mostly any time, as it gives me freedom or free time to do activities, ask queries to my instructors online, and attend consultation meetings through Zoom and Google Meet without any hassle in preparation." (BEEd Learners - PPC Campus)*]. These tools enabled them to stay connected with their teachers and classmates, regardless of location. Additionally, students utilized math-related tools such as Mathway, Photomath, Gauthmath, Symbolab, Geogebra, Desmos, and scientific calculator apps to enhance their understanding of mathematical concepts [*"We have become aware of various applications such as Symbolab, Gauthmath, Mathway, Photomath, and Desmos, which assist us in checking our answers and meeting our learning needs in mathematics. These software tools have been helpful in our studies. Since we do not have access to scientific calculators due to their high cost,*

we have downloaded scientific calculator apps on our mobile phones as an alternative. This has helped us save on expenses." (BSEd Math Learners - PPC Campus)]. Online tutorials, resources, and platforms like YouTube and educational websites further supported their learning [*"We have become familiar with using various tools that can aid us in the learning process. We often rely on YouTube tutorials to understand how to use different tools effectively. In addition to that, we frequently utilize Google for research and finding additional resources." (BSEd Math Learners - Main Campus)*].

Student support services were also extended through bridging connections and increasing engagement. Online events, webinars, and extracurricular activities organized by student organizations and the university allowed students to participate in activities of interest [*"We can participate in extracurricular activities and pursue our professional interests online. The school offers online training and seminars that align with our academic and professional interests. They have also organized activities that do not require us to leave our homes, such as online events organized by the student council." (BEEd Learners - Main Campus)*]. Learning materials were accessible through flash drives, online libraries, and module bags [*"The university provided bags and flash drives to store our files and learning materials." (BSEd Math Learners - PPC Campus)*].

Plan of Action to Enhance the Flexible Teaching and Learning Modalities of MTEs

The proposed action plan (see Appendix) aims to enhance the flexible teaching and learning modalities of MTEs. The plan emphasizes revising teaching methods, incorporating technology, revising assessment modalities, and promoting timely feedback to create a flexible and inclusive learning environment. The research findings support the action plan's objectives, aligning with the need for increased flexibility, inclusivity, and technology-driven education.

DISCUSSION

Flexible Teaching and Learning Modalities Employed by the MTEs

The MTEs successfully implemented flexible and inclusive instruction combining modular and online learning. They employed various assessment methods to evaluate learners' progress and provided timely feedback. These findings align with previous research and contribute to learners' long-term educational development. Online resources, communication channels, and flexible classroom policies facilitated effective teaching and learning experiences. Generally, Flexiclusive: Flexible and Inclusive Instruction emerged among MTEs, who aimed to create a flexible and inclusive learning environment by combining modular instruction with online learning opportunities. Multiple resources were utilized to accommodate different learners, allowing them to engage with the content in diverse ways, fostering a supportive learning environment by addressing questions and concerns, and emphasizing flexibility and open communication channels to accommodate individual circumstances and needs. This finding is favorable since modular and online learning fostered autonomy and self-directed learning (Bacomo et al., 2022), benefitting learners' long-term educational development. Meanwhile, the general code emerging was MTEs' ComPass Tick: Comprehensive Assessment and Timely Feedback, which highlights their commitment to using various assessment modalities aligned with learning objectives. In connection with Harris and Jones (2021) and Van Nuland et al. (2020), using the best modalities to create assessments, grading complex tasks using rubrics, and aligning test questions and

performance tasks to learning objectives are all techniques instructional designers can use to create high-quality assessments.

Learners' General Assessment of the Flexible Teaching and Learning Modalities in Math Education

The accessibility of printed modules at designated areas and electronic modules through platforms like Google Classroom was recognized. Learners appreciated the continuous updating of instructional modules and the flexibility to pace and schedule their tasks. Assessments indicated in the modules allowed them to assess their learning and track progress. However, the perceived effectiveness of modular learning for improving understanding was slightly lower. Although Sanchez et al. (2022) reported challenges among learners during modular instruction, this study showed that printed modules were accessible. This finding suggests that learners found the materials available through different mediums, catering to their preferences or circumstances. However, the effectiveness of modular learning for improving understanding was perceived as slightly lower, although still generally positive. Hamora et al. (2022) indicated that there might be room for further enhancements in its implementation.

The learners acknowledged the convenience of attending classes from home, accessing course materials and resources online, and the availability of online academic advising. However, there were varying opinions regarding online education's effectiveness and convenience. Like Muthuprasad et al. (2021), the results imply that not all learners viewed online education as equally beneficial or convenient. The result suggests that some learners may have found online learning effective and convenient, similar to Almahasees et al. (2021), while others may have had reservations or encountered difficulties with this mode of education. Individual learning preferences, technological factors, and personal situations could influence these differing views.

These findings suggest that while learners generally appreciate the flexible modalities used in online and modular instruction, there are differing perspectives on the effectiveness and convenience of these modes of education. Individual learning preferences, technological considerations, and personal circumstances may contribute to these opinions. Educators need to consider these factors when designing and implementing flexible teaching and learning modalities in math education, aiming to enhance the overall learning experience for all learners.

Opportunities Provided during the Implementation of Flexible Teaching and Learning

During the implementation of flexible teaching and learning, mathematics educators (MTEs) have embraced CuRing: Course Reengineering as a pivotal opportunity. Similar to the perspectives proposed by Cassidy et al. (2016) and Hamora et al. (2022), this underscores the importance of redesigning and adapting courses to suit the needs of flexible teaching and learning. MTEs are leveraging digital tools and innovative instructional methods to ensure the delivery of high-quality mathematics education. In addition, faculty development emerges as a crucial opportunity during flexible teaching and learning, encapsulated by CoPeD: Continuing Professional Development. This ongoing learning process enables MTEs to grow as educators, empowering them to effectively navigate the challenges of flexible teaching and learning while delivering top-notch education to their mathematics students (Al-Thani et al., 2021). These opportunities strengthen the need to continually review and revise mathematics instruction with the emerging trends while

equipping each mathematics educator with the needed training and preparation towards resiliency in classroom instruction.

Assessment and evaluation also play a vital role in implementing flexible teaching and learning, with the emergence of IPasA: Inclusive Practices in Assessment. MTEs are embracing assessment flexibility to address the challenges posed by the pandemic and ensure equitable opportunities for all learners. They are incorporating authentic assessment methods to foster creativity, collaboration, and critical thinking skills through real-world problem-solving activities. These tasks are necessary to develop metacognitive awareness and advance mathematical performance among learners (Oficiar et al., 2024; Pentang et al., 2023). In mathematics teaching, the integration of technology, as emphasized by Tech EmpowerEd: Empowering Education Through Technology, presents a significant opportunity for enhancing pedagogical practices. Similar to the findings of Dayagbil et al. (2021), providing technological resources can empower educators to deliver flexible teaching approaches tailored to diverse student needs. As Asio et al. (2021) highlighted, leveraging technology can substantially augment the effectiveness of online instruction, fostering an environment conducive to learning in the digital space. Flexible situations have created opportunities for inclusive assessment and technology integration in mathematics teaching. The inclusive assessment ensures fairness for all learners, while technology integration enhances engagement and personalized learning experiences. Educators adapt traditional approaches, embrace innovative assessment methods, and leverage digital tools to support diverse student needs in changing educational contexts, particularly mathematics.

Technology also provided opportunities to support flexible teaching-learning in mathematics regarding communication. Mariano-Dolesh et al. (2022) and Santiago et al. (2021) underscored that communication tools and applications are vital in facilitating mathematical learning and connectivity among students and educators. By engaging with these digital resources, learners can deepen their comprehension, verify solutions, and explore various mathematical concepts, enriching their educational experiences. Implementing flexible teaching and learning methodologies enables students to access essential services and resources and sustains their engagement in mathematical education amidst the challenges posed by the pandemic. Aligning with the OECD (2020), such support ensures that learners' well-being and fundamental needs are addressed, cultivating a nurturing environment conducive to their academic endeavors. Thus, by harnessing technology and adopting flexible instructional approaches, educators can effectively empower students to thrive in their mathematical learning journey, irrespective of external circumstances.

Plan of Action to Enhance the Flexible Teaching and Learning Modalities of MTEs

The proposed action plan offers a comprehensive strategy for enhancing the flexible teaching and learning modalities within mathematics classrooms, explicitly focusing on MTEs. By prioritizing the revision of teaching methods, integration of technology, adaptation of assessment modalities, and facilitation of timely feedback, the plan aims to foster a more adaptable and inclusive learning environment. Through adopting diverse teaching techniques, such as active learning and collaborative problem-solving, MTEs can engage students with varied learning styles more

effectively. Moreover, incorporating digital tools and resources enables MTEs to provide interactive learning experiences and facilitate remote learning when necessary. By revising assessment methods to include a broader range of formative and summative approaches, MTEs can better assess students' understanding and skills in mathematics. Additionally, promoting timely feedback through peer assessment or digital platforms ensures that students receive personalized guidance and support to enhance their learning outcomes. Overall, the action plan emphasizes the importance of flexibility, inclusivity, and technology integration in mathematics education, aligning with research findings that underscore the need for innovative approaches to teaching and learning in this field.

CONCLUSION AND RECOMMENDATION

Conclusion

The MTEs have successfully implemented a combination of modular instruction and online learning to address learners' challenges, providing personalized instruction, flexibility, and offline access to educational materials. Integration of online components has enhanced engagement and accessibility, supported by communication channels for seeking support and addressing concerns. The MTEs have effectively monitored student progress, provided timely feedback, and employed diverse assessment methods aligned with learning objectives. These flexible teaching and learning modalities have catered to learners' needs, fostering a supportive and inclusive environment. Learners appreciated the flexibility of online and modular instruction, allowing them to learn anytime and anywhere. Online assessments helped monitor progress, but there was less agreement on the effectiveness and convenience of online teaching. Similarly, learners recognized the benefits of modular learning, but slightly less agreement was observed in this aspect. Flexibility is valued, but improvements can be made to enhance online instruction and optimize the benefits of modular learning.

The study findings highlight flexible teaching and learning implementation opportunities for both MTEs and learners. MTEs demonstrated adaptability and creativity in course design, utilizing digital platforms, multimedia elements, and online discussions to cater to learners' needs. They actively engaged in faculty development, enhancing technological proficiency and teaching experience. Assessment methods have become more flexible and technology-driven. Infrastructure and technical support facilitated the implementation by providing necessary resources. These opportunities empowered MTEs to create personalized learning experiences, fostered student engagement, and improved learning outcomes. Faculty development initiatives kept MTEs updated, while inclusive assessment modalities promoted creativity and critical thinking. The provision of infrastructure and technical support eliminated access barriers for seamless implementation. Enhancing flexible teaching and learning modalities is crucial for inclusive education. The proposed action plan includes a comprehensive review of teaching methods and materials, faculty professional development, and integration technology. Alternative assessment methods and transparent criteria are emphasized. Execution of the plan fosters continuous improvement and collaboration among faculty. Success is measured by increased participation in professional development, feedback from faculty and students, and technology integration. Prioritizing flexibility creates engaging and inclusive learning environments that meet diverse

learner needs. The alignment between findings and the action plan enhances the validity and relevance of proposed strategies for effective teaching and learning.

Recommendations

Educational institutions and teachers should embrace flexible teaching and learning modalities by integrating modular and online learning, providing personalized instruction, and accommodating learners' circumstances. Institutions should support teachers in creating high-quality modules and using online platforms effectively. Communication channels, such as group chats and online consultations, should be established to address learners' questions. Teachers should monitor student progress, provide timely feedback, and adjust teaching strategies accordingly. Assessment methods should combine formative and summative approaches, ensuring validity and fairness through rubrics and precise alignment with objectives. Timely feedback should be given to support learners' progress and encourage improvement.

To improve flexible teaching and learning in online and modular instruction, educators should focus on enhancing effectiveness through instructional design and pedagogical strategies. They should also conveniently streamline the online learning experience with user-friendly interfaces, clear instructions, and technical support. They must also provide additional support and guidance for learners in modular learning through clear instructions, communication channels, and scaffolding resources. These measures optimize learner engagement and outcomes. This study recommends several ways to enhance the implementation of flexible teaching and learning in mathematics education. These include prioritizing teacher professional development, integrating technology into instruction, promoting educator collaboration, and using inclusive assessment methods. These measures aim to improve instructional strategies, support teacher growth, and enhance students' learning experiences in mathematics. To enhance flexible teaching and learning, an educational institution should execute a well-developed action plan, including reviewing teaching methods, providing professional development, integrating technology, and implementing flexible assessments. They should monitor success indicators, gather feedback, and continuously refine the plan based on evolving needs. Fostering a culture of collaboration among faculty members is essential for sustaining and expanding flexible teaching and learning modalities.

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APPENDIX

Action Plan to Enhance the Flexible Teaching and Learning Modalities

Area	Tasks/ Objectives	Activities	Strategy of Execution	Performance Indicator
Instruction	Conduct a comprehensive review of current teaching methods and materials to identify areas for improvement.	Form a review committee to assess current teaching methods and materials. Gather feedback from faculty members through surveys or interviews. Analyze data to identify strengths and weaknesses. Document findings and recommendations for improvement.	Allocate budget for committee meetings and consultations. Invest in research materials and resources. Conduct surveys or focus groups with faculty and students	Number of teaching methods and materials reviewed. Identification of specific areas for improvement. Development of a comprehensive report outlining the findings and recommendations.
	Develop a professional development program for faculty to enhance their skills in flexible teaching strategies.	Assess faculty members' needs and interests through surveys. Design workshops and webinars on flexible teaching strategies. Create user-friendly learning materials for the program. Offer ongoing support and mentoring during implementation.	Design and develop training materials and resources Conduct workshops or training sessions. Provide incentives or honoraria for guest speakers or experts	Number of faculty members participating in the professional development program. Completion of training sessions or workshops on flexible teaching strategies. Evaluation of faculty members' skills and knowledge enhancement through pre-and post-training assessments or surveys.
	Provide resources and support for the implementation of technology-enhanced teaching methods.	Identify and curate a list of user-friendly technology tools. Develop user guides and tutorials for faculty members. Provide hands-on training sessions for using technology tools. Establish a helpdesk or support system for technical assistance.	Invest in technology infrastructure and equipment. Purchase educational software or platforms. Provide training and technical support for faculty	Availability and accessibility of technology resources provided to faculty members. Number of faculty members utilizing technology-enhanced teaching methods. Feedback from faculty members regarding the effectiveness and usefulness of the provided resources and support.
	Encourage collaboration and sharing of best modalities among faculty members.	Create an online platform for faculty members to connect and share ideas. Organize faculty meetings or workshops for knowledge exchange. Facilitate peer mentoring and observation programs. Recognize and reward contributions to best modality sharing.	Organize faculty forums or conferences. Develop an online platform or community for sharing the best modalities. Provide incentives or rewards for faculty members who contribute or present their best modalities.	Number of collaborative activities or initiatives among faculty members. Participation and engagement in sharing best modalities through workshops, presentations, or online platforms. Feedback from faculty members indicating increased collaboration and knowledge sharing.

Area	Tasks/ Objectives	Activities	Strategy of Execution	Performance Indicator
Assessment	Review and revise existing assessment modalities to align with flexible teaching methods.	Evaluate current assessment methods to identify areas for improvement. Modify assessments to accommodate flexibility in learning environments. Ensure assessments align with course objectives and learning outcomes.	Allocate budget for committee meetings, consultations, and coordination efforts. Invest in assessment analysis tools or software. Conduct faculty and student surveys or focus groups. Design and distribute communication materials for revised assessment modalities	Number of assessment modalities reviewed and revised. Alignment of assessment modalities with flexible teaching methods. Feedback from faculty and students on the effectiveness of revised assessment modalities.
	Explore alternative assessment methods, such as project-based assessments and formative assessments.	Research and consider alternative assessment approaches suitable for flexible teaching. Introduce project-based assessments to assess the practical application of knowledge. Incorporate formative assessments for continuous feedback and progress monitoring.	Research and acquire resources on alternative assessment methods. Develop training materials and resources. Conduct workshops or training sessions. Share success stories through online platforms or events.	Identification and introduction of alternative assessment methods. Adoption and implementation of project-based assessments and formative assessments. Feedback from faculty and students on the suitability and impact of alternative assessment methods.
	Provide training and support for faculty to design and implement flexible assessments.	Offer training sessions on designing flexible assessments. Provide resources and examples of effective, flexible assessment strategies. Support faculty in implementing flexible assessments in their courses.	Develop a professional development program. Provide resources and materials for faculty training. Allocate budget for mentoring or coaching sessions. Establish an online platform or community.	Number of faculty members receiving training on flexible assessment design. Completion of training sessions or workshops on flexible assessments. Faculty members' feedback indicates increased confidence and competence in designing and implementing flexible assessments.
	Establish clear and transparent assessment criteria and rubrics.	Develop clear assessment criteria aligned with learning objectives. Create transparent rubrics to guide evaluation and grading. Communicate assessment criteria and rubrics to students for clarity.	Develop assessment criteria and rubrics. Design and distribute communication materials. Conduct training sessions on assessment criteria and rubrics. Regularly review and update assessment criteria and rubrics	Development of clear assessment criteria and rubrics aligned with learning outcomes. Communication of assessment criteria and rubrics to faculty and students. Feedback from faculty and students on the clarity and usefulness of assessment criteria and rubrics.