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Instruction Modalities in the Students' Academic Performance in Mathematics: Students' Challenges and Teaching Strategies

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A B S T R A C T

Adoption of different teaching modes to maintain mathematical learning was spurred by the COVID-19 epidemic. In order to investigate the disparities in mathematics performance between online, hybrid, and in-person classes, as well as the learning difficulties and instructional tactics of the teachers, this study used a mixed-methods explanatory sequential design that integrated quantitative and qualitative analyses. Official grades in three mathematics courses taken by the same group of 44 Bachelor of Science in Computer Science students over the course of three semesters served as the quantitative data. Friedman test results with post hoc test revealed that performance varied significantly between modalities, with face-to-face classes yielding the best results. The qualitative phase revealed recurring issues such erratic internet availability, restricted device use, and trouble adjusting to different class schedules. Mathematics teachers addressed these with flexible time of submission procedures, digital resources, and lecture recordings. The study concluded that although a variety of modalities can enhance mathematics learning, face-to-face education is still the most effective since it allows for fuller interaction and instant feedback. This conclusion is supported by the Community of Inquiry and Constructivist Learning frameworks. The findings recommend of creating proven tools to measure students' difficulties and link them to academic achievement, as well as provide ideas for creating adaptable learning environments.

RESUMO

A adoção de diferentes modalidades de ensino para manter a aprendizagem da matemática foi impulsionada pela pandemia de COVID-19. Para investigar as disparidades no desempenho em matemática entre aulas online, híbridas e presenciais, bem como as dificuldades de aprendizagem e as estratégias de ensino dos professores, este estudo utilizou uma metodologia mista explicativa sequencial que integrou análises quantitativas e qualitativas. As notas oficiais de três disciplinas de matemática cursadas pelo mesmo grupo de 44 alunos de Bacharelado em Ciência da Computação ao longo de três semestres serviram como dados quantitativos. Os resultados do teste de Friedman com teste post hoc revelaram que o desempenho variou significativamente entre as modalidades, com as aulas presenciais apresentando os melhores resultados. A fase qualitativa revelou problemas recorrentes, como disponibilidade irregular de internet, uso restrito de dispositivos e dificuldade de adaptação a diferentes horários de aula. Os professores de matemática abordaram esses problemas com procedimentos flexíveis de entrega de trabalhos, recursos digitais e gravações de aulas. O estudo concluiu que, embora uma variedade de modalidades possa aprimorar a aprendizagem da matemática, o ensino presencial ainda é o mais eficaz, pois permite uma interação mais completa e feedback instantâneo. Essa conclusão é corroborada pelos referenciais da Comunidade de Investigação e da Aprendizagem Construtivista. Os resultados recomendam a criação de ferramentas comprovadas para mensurar as dificuldades dos alunos e relacioná-las ao desempenho acadêmico, além de fornecer ideias para a criação de ambientes de aprendizagem adaptáveis.

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INTRODUCTION

A variety of teaching methodologies are employed in the classroom to make the subject matter easier to learn, especially in Mathematics education. Mathematics instructor must undergo significant training to successfully teach mathematics subjects because it presents many difficult teaching challenges. This aligns with the findings of *Ball, Thames, and Phelps (2008)*, who emphasized that teaching mathematics requires specialized pedagogical content knowledge to address learners' conceptual and procedural difficulties. Institutions faced the challenge of ensuring learning continuity while maintaining quality instruction, particularly in subjects such as mathematics that demand conceptual understanding and active problem-solving (Dhawan, 2020; Mseleku, 2022). However, abrupt changes have emerged as a result of the COVID-19 Pandemic, and some nations have encountered numerous difficulties, especially in the area of education, where the nations were compelled to convert from in-person to remote learning.

During the COVID-19 pandemic (2020–2022), when most educational institutions shifted from traditional classroom instruction to remote modalities, different countries adopted different models of distance education for different goals. All of the models combined, which were employed by different universities, were called Emergency Remote Teaching (ERT). Hodges et al. (2020) defined ERT as a quick transition from one type of instruction to another due to an emergency. According to Keese et al. (2022), remote learning became a stand-by procedure that allowed schools to carry on with instruction even when their physical campuses were closed. Many educators, teachers, and students were unfamiliar with ERT, but they were forced to implement it since the pandemic forced the closure of most schools, necessitating the search for creative ways to offer educational opportunities to students at all educational levels.

Despite the numerous advantages associated with distant or remote learning and teaching, research has shown that the drawbacks of this approach to education are incalculable. Early research (Kraft et al. 2020; Kuhfeld and Tarasawa 2020; Ocak 2020) indicates that COVID-19 has had a detrimental effect on students' learning, accomplishments, learning opportunities, and health outcomes to differing degrees. Ocak (2020) asserts that discussions conducted remotely through online distance learning are of worse quality between the instructor and the student. Because the classroom is so complicated, it is essential to organize each lesson in a way that preserves each student's autonomy during the process of learning and instruction. However, because they are unable to build and maintain effective conversations with students during instruction, it may be difficult for teachers to provide constructive feedback that might help each student acquire a conceptual knowledge of the subjects they are learning. Comparable results were also obtained from earlier studies conducted before the pandemic's commencement.

Teaching mathematics in online classes

Given that some of the teachers are not proficient in using technology as a teaching tool, the math teachers faced challenges regarding how they would deliver the material through virtual classrooms. The learners, however, are more inclined to technology than previous generations; their issues resulted from the devices' limited availability and slow internet connections. According to the study of Bringula, R., et. Al (2021), found that as physical learning spaces are a crucial component of virtual learning environments, online learners have access to devices. The physical spatial limitations of certain online learners, however, add to the unique characteristics of the distance learning environment. This restriction made their poor opinion of themselves as academics even worse. Regarding their ability in mathematics and degree of interest in learning the topic, online learners hold varying viewpoints. They expressed uncertainty about what grades they might receive at the end of the semester. The

ability to learn mathematics at one's own pace is the most sought-after ability for distance learners. Furthermore, students who engage online and have fewer resources for learning are more likely to have a lower self-concept in mathematics because they find it harder to focus on the course. Thus, it may be said that a learner's profile has an impact on their self-concept in mathematics when they are enrolled online.

Mathematics instructors play a vital role in helping online learners overcome negative self-perceptions and anxiety toward mathematics learning. Teachers must design technology-mediated lessons that sustain engagement, foster confidence, and reduce cognitive overload (Rapanta et al., 2021; Mseleku, 2022). To test students' unfavorable beliefs about their mathematical skills, mathematics instructors may often employ interactive multimedia lessons, recorded lessons, and short video discussion that allow students to review and watch content at their own pace even with limited internet access (Boholano, 2021; Dela Cruz & Lapinid, 2023).

Moreover, teachers' consistency, empathy, and flexibility are critical to the success of these strategies, these qualities have been demonstrated to boost student satisfaction and lower attrition in online mathematics subjects (Ferri, Grifoni, & Guzzo, 2023). Also, Online meetings continue to be vital for explaining difficult mathematical ideas and preserving social interaction, both of which increase students' drive and perseverance (Sahu, Singh, & Mishra, 2022; Garrison et al., 2020). As a result, online mathematical environments, mathematics teachers' pedagogical dedication and technology competence are important for helping successful learning outcomes.

Recent studies, mathematics teachers must use innovative and adaptable teaching methodology to improve student engagement and address students' negative self-perceptions when teaching mathematics online. Though their instructional design has a significant impact on students' confidence, motivation, and learning results, mathematics teachers regularly struggle in the integration of technology (Mseleku, 2022; Rapanta et al., 2021). Mathematics teachers use video recorded lectures and lessons, and multimedia presentations to provide engaging learning experiences that students may access even with poor connectivity (Boholano, 2021; Dela Cruz & Lapinid, 2023).

Some researches, also indicates that achievement in online mathematics strategies is significantly predicted by students' self-efficacy, self-regulated learning, and intrinsic motivation (Adarkwah, 2021; Nguyen, Nguyen, & Tran, 2022). Also, teachers' technological proficiency, empathy, and commitment to developing learner-centered environments that strike a balance between flexibility and meaningful connection are what make online mathematics instruction effective. Additionally, the mathematics teacher's presence, demonstrated through regular consultations, problem-solving exercises, and instant feedback, improves persistence and cognitive engagement (Sahu, Singh, & Mishra, 2022; Ferri, Grifoni, & Guzzo, 2023). Ultimately, appropriate examples and well-structured online exercises foster deeper comprehension and lessen arithmetic fear (Gajardo & Gómez, 2023).

Teaching mathematics in hybrid classes

Hybrid class is a teaching methodology combines traditional face-to-face classes with online classes. There are instances when an online discussion is added to the online teaching materials to allow students to further discuss the lessons being covered. Employing online classes can minimize the need for students to attend the face-to-face classes. This approach is still evolving as a teaching strategy that combines technology-based resources, delivery methods, teaching models, and learning styles to produce an adaptable and captivating learning environment. This encourages the efficient and successful integration of pedagogical approaches, digital resources, and instructional tactics to meet the requirements of various learners and foster autonomous, sustainable, and lifelong learning patterns. Additionally, these hybrid classrooms preserve in-person connections while enabling students to access lessons at any time. In order to improve student engagement and achievement in hybrid programs, parents and math teachers continue to play crucial roles, with parents offering support and educators encouraging learning.

Adaptive learning environments that integrate technology, collaborative tactics, and diverse teaching styles are fostered by hybrid strategies, which tackle both educational possibilities and difficulties. These innovations continue to shape hybrid learning, enabling the construction of sophisticated teaching and learning settings that reach beyond traditional classrooms. Combining in-person, online, and offline instruction guarantees that students not only successfully meet learning objectives but also form adaptable, independent, and sustainable learning habits for the rest of their lives. Worldwide, hybrid learning has gained popularity as a concept for training and higher education.

Teaching mathematics in face-to-face classes

Since many math instructors were trained in the conventional "chalk and talk" method and have little exposure to cutting-edge teaching strategies, they find it difficult to give up control of the classroom (Biehler, 2024). Furthermore, traditional lectures are still a major part of teaching mathematics in higher education for a number of reasons. According to Dietrich and Evans (2022), one contributing aspect is the continued use of curriculum that are condensed and resource-constrained, which limits the opportunity for alternate teaching approaches. Further supporting the idea that lectures are still the best way to explain difficult ideas and preserve the discipline's logical flow is the fact that mathematics is frequently seen as being extremely disciplined and objective (Zielinski, 2023).

According to Dietrich and Evans (2022), lectures can be adapted to model mathematical thinking, inspire students, and convey essential concepts while incorporating active and collaborative elements. And, beyond the transfer of knowledge, lectures can address both cognitive and affective aspects of learning, such as student motivation, identity, and engagement. By integrating individual and group tasks, frequent feedback, and interactive components, traditional lectures can evolve to foster deeper understanding and active participation, ensuring that students engage meaningfully in the learning process (Biehler, 2024; Zielinski, 2023).

While traditional lectures may contain "'impact' variables like tradition, passion, and identities, as well as 'cognitive' elements associated with instruction," Pritchard contends that instruction should address these as well. Additionally, he claims that a typical lecture serves the three purposes of inspiring, conveying, and modeling. These roles were "strengthened and expanded with individual and collective tasks and frequent criticism," involving students in active processes as opposed to the gradual transfer of knowledge.

Synthesis: This research highlights consistent evidence that teaching methods affect student engagement and success; however, the results remain indeterminate in mathematical contexts. This highlights the need for integrated analyses that combine performance data with learner experiences — a gap this research aims to address. While there has been extensive research on flexible and online learning during the pandemic, few studies have examined the performance of the same group of students in various mathematics course modalities (online, hybrid, and face-to-face).

Pandemic, few studies have examined the performance of the same group of students across various mathematics course delivery methods (online, hybrid). Furthermore, the majority of local studies have focused on perceptions rather than performance results. Also, most local studies have focused on perceptions rather than performance outcomes. This research addresses this gap by examining academic performance across different learning modes and exploring specific challenges related research fills this gap by studying academic performance across different learning modes and examining specific difficulties related to teaching mathematics.

he main objectives of the research were to determine the student's academic achievement in mathematics using instruction modalities, as well as the difficulties that students faced and the strategies that teachers utilized to assist them before and following the COVID-19 Pandemic.

This study aimed to determine the level of academic performance of the students in mathematics in terms of: 1.1 Online Classes; 1.2 Hybrid Classes; 1.3 Face-to-face. Classes 1.determine the significant differences between the three instruction modalities in academic performance in Mathematics through: 2.1 Online Classes; 2.2 Hybrid Classes; 2.3 Face-to-face Classes: explore the challenges that students face when instructional settings suddenly change: and strategies that teachers utilized to help the students conquer these challenges during and after the COVID-19 Pandemic.

Methodology

An explanatory sequential mixed-methods design was employed to examine the effects of different instructional modalities on students' academic performance in Mathematics. This design was used because it allowed the researcher to first identify measurable performance of the students across the three instructional modalities and then explain these results through participants' lived experiences. The sequential integration of quantitative and qualitative phases provided a deeper understanding of not only *what* significant differences showed but also *why* these differences observed, ensuring that statistical findings were grounded in contextual insights from both students and mathematics teacher.

The design began with a quantitative phase to determine the level of academic performance of the students, also significant differences in student performance across online, hybrid, and face-to-face classes. After this, a qualitative phase was conducted to investigate the underlying experiences and perspectives of students and mathematics teacher. This phase aimed to uncover the challenges students faced during sudden shifts in instructional settings and to understand the strategies teachers employed to support them. By combining both approaches sequentially, this design allows the quantitative results to be explained and enriched with qualitative insights, yielding a more complete understanding of the instructional modalities' impact on learning outcomes.

Participants of the Study

In this study, total population sampling—a type of purposive sampling—was used because all 44 Bachelor of Science in Computer Science students who finished the three mathematics courses were included. Despite its small size, the sample gives a comprehensive picture of the cohort's performance trends because it includes all instructional modalities.

By using the same cohort of students throughout the three modalities, the study controlled for individual variations even while the subjects' mathematical content and cognitive demands varied. As a result, rather than subject difficulty, performance variances can be primarily ascribed to the way instruction is delivered. This method acknowledges that future research may use a genuine experimental design to further isolate modality effects while still enabling the researcher to fairly compare achievement trends across modalities.

Data Gathering Procedure

This study attained the official grades of the participants in three Mathematics subjects to examine the level of academic performance and differences in academic performance across instruction modalities. Specifically, the grades in Math 1 (Analytic Geometry) during the 1st semester of A.Y. 2022–2023 utilizing online classes, the grades in Math 2 (Calculus) during the 2nd semester of A.Y. 2022–2023 utilizing hybrid classes, and the grades in Math 3 (Linear Algebra) during the 1st semester of A.Y. 2023–2024 utilizing face-to-face classes were collected from the campus registrar. These data were used to determine the level of academic performance and significant differences between the three instructional modalities.

Next phase, a qualitative method was conducted to explore the experiences and perceptions of the students regarding each instructional modality. Participants answered an open-ended questionnaire designed to capture: what are the challenges encountered and experienced by the students under online, hybrid, and face-to-face classes; what are the strategies employed by mathematics teacher to address these challenges and what is the preferred instructional modality of the students among the online, hybrid, and face-to-face classes and reasons for their preference.

But on the future studies, it is suggested to develop a standardized survey instrument based on the identified challenges and strategies experienced by the students. This data may

be used to measure the frequency of students' experiences in various instructional modalities and to correlate these data with their academic performance for deeper statistical analysis.

Ethical Considerations

The study obtained ethical approval from the university. Participation was voluntary, and students were informed of their right to withdraw at any stage without any academic penalty. Informed consent was obtained in writing prior to participation. To maintain confidentiality, official grades and questionnaire responses were anonymized, with codes assigned to each participant. Data were securely stored in password-protected files accessible only to the researcher and will be destroyed three years after publication, in accordance with institutional data retention policies.

Statistical Treatment

Grade Point Average was used to determine the average grade of the students in three Mathematics subjects in terms of the three instructional modalities.

GRADE	PERCENTILE RANGE	REMARKS
1.00	96.7 - 100	Excellent (Highest Grade)
1.25	93.4 - 96.6	
1.50	90.1 – 93.3	Very Good
1.75	86.7 - 90.0	
2.00	83.4 - 86.6	
2.25	80.1 - 83.3	Good
2.50	76.7 - 80.0	
2.75	73.4 - 76.6	
3.00	70.0 - 73.3	Passing Grade
4.00	50.0 - 69.9	Conditional Grade has to be removed by taking a removal examination either to obtain a grade of "3.00" or slide to "5.00"
5.00	49.9 & below	Failed

Friedman Test with Post-hoc Test was used to determine the significant difference between the three Mathematics subjects in terms of the three instructional modalities.

Result and Discussion

Table 1.
Academic Performance of Computer Science Students in the three semesters

Subject	*GPA*	*Remarks*
Analytic Geometry (Online Class)	81.95	GOOD
Calculus (Hybrid Class)	84.91	GOOD
Linear Algebra (Face-to-Face)	88.32	VERY GOOD
AVERAGE	**85.06**	**GOOD**

It showed in Table 1 the academic performance of the students in the three Mathematics subjects via online class, hybrid class, and face-to-face class. Since the remarks of the academic performance of the students was Good. It means that any mode of instruction can student still catch up to their lessons, especially in Mathematics subjects. But still, the face-to-face mode of delivery was most effective in teaching mathematics since it has a Very Good remark.

Students have been shown to have significantly greater learning outcomes, as indicated by their performance in the F2F delivery method for the introductory class, which is corroborated by the research of Burns, K., et al. (2013). The results of this study also showed that the performance of a pupil in the basic computer science course, regardless of whether it was taken online, in-person, or hybrid, was significantly influenced by their GPA. This could be explained, for example, by the fact that students who have formed study habits that support a certain degree of success maintain that level of performance independent of the mode of instruction.

This study discovered that a student's GPA was the most important factor in determining whether or not they would succeed in the second, more complex information systems course. These results might add to the body of research suggesting that, regardless of the manner of course delivery, GPA is the most important element in determining a student's success (Li, Uvah, and Amin, 2012).

Table 2.
Friedman Test and Pos-Hoct Test table of the three modalities

	Mean	***SD***	***p-value***	***Remarks***	***Pairwise***	***p-value***	***Remarks***
Online Classes	81.96	6.78	0.00	Significant	Online and Hybrid	0.004	Significant
Hybrid Classes	84.93	7.67			F2F and Hybrid	0.000	Significant
Face-to-Face Classes	88.32	5.98			Online and F2F	0.000	Significant

α = 0.05

The post-hoc analysis further revealed that students achieved the highest performance in face-to-face classes, followed by hybrid classes, while online classes yielded the lowest mean scores. This ranking confirms that the more direct and interactive the instructional modality, the better the students performed in mathematics. The result underscores the critical role of immediate feedback, peer interaction, and structured engagement, which are more prominent in face-to-face settings.

The findings indicate that there is a substantial difference ($p < 0.05$) in the way that students are taught Mathematics subjects across the three different instruction modalities. This suggests that a student's academic success in mathematics may be related to one of three types of education. It demonstrates how the key distinctions across hybrid, online, and in-person classes are rooted in their different approaches to engagement, delivery, and learning settings. Every format has particular benefits and drawbacks that affect learning outcomes, student engagement, and the quality of education as a whole.

Moore, M. G. (1989) talked about the value of engagement in distance learning, highlighting how various delivery methods affect the type and standard of communication between teachers and students. Allen, I. E., & Seaman, J. (2017) highlight the increasing need for online learning because of its accessibility and flexibility, which appeal to non-traditional students juggling several responsibilities. Based on the demands and challenges of the students, each mode of instruction has a specific role to play in assisting the teachers in discussing or delivering the lessons to the class successfully and quickly. The research conducted by Garrison, D. R., and Kanuka, H. (2004) examined the advantages of hybrid learning, or blended learning, pointing out that it combines the best aspects of online and in-person learning environments to offer a more comprehensive educational experience.

Students' Challenges during Online Classes:

Many students' challenges were raised during online classes; 1) the majority of the students have no internet connections or mobile data to attend the online classes regularly and submit any requirements that need to be uploaded online because some of the students cannot

afford to subscribe in some internet provider due to their economic status. 2) Available devices that the students can use during the online classes, some of the students' shared devices to their siblings who also attending online classes. Lastly, 3) A lot of distraction due to noises in the environment. With these problems, the students cannot perform well in the subjects since many of the students cannot attend online classes regularly because of the difficulty in the internet connectivity and available devices that can be used.

Beyond technological limitations, students also encountered mathematics-specific difficulties such as understanding symbolic representations, visualizing geometric or algebraic relationships, and following multi-step problem-solving procedures without real-time guidance. The absence of physical interaction and immediate instructor feedback often led to misconceptions and reduced confidence in solving abstract problems. These challenges highlight that online environments must be supported with scaffolding tools—such as interactive simulations, digital whiteboards, and step-by-step video tutorials—to sustain conceptual understanding in mathematics.

Students' Challenges during Hybrid Classes:

Some schools adopted a hybrid class model of education, where teachers and students receive the schedules for both in-person and online programs, as a preventive measure against COVID-19. Nonetheless, students continue to encounter the following difficulties: 1) uncertainty over the online and in-person class schedules, as there are situations in which online classes switch to in-person sessions and vice versa. With this, students found it difficult because they could not manage their time and tasks effectively because of the sudden changes in their schedules. 2) Confusion about the submission of activities and tasks because some students submitted their activities face-to-face but they should be submitted online. And those activities that they need to submit online they submitted it face-to-face. Finally, 3) students had to manage their time well since they had to switch between in-person and online classes while completing a variety of responsibilities. When completing academic tasks, they could become easily sidetracked or run out of time. Due to sudden shifts in the manner of education, these kinds of student obstacles may impair their ability to pay attention to the lesson. They turn their attention away from the arithmetic lesson and toward keeping track of the times for both online and in-person sessions as well as submitting their assignments and activities.

Students' Challenges during Face-to-face Classes:

Later COVID-19 Pandemic, a new normal for education in the Philippines was implemented and almost 100% of the schools in the Philippines implemented limited face-to-face classes. But still, some students faced challenges during the limited face-to-face classes. Their adjustment from online and hybrid to limited face-to-face becomes a challenge to the students because they are absent from the classes or forget the lesson, and they can no longer repeat the lesson. Unlike online and hybrid, they have a copy of the recorded video of the classes that they can play anytime. With this, the students need to be more attentive and focused on the lesson.

Despite these challenges faced by the students on the three instruction modalities, the students still preferred the face-to-face classes simply because they liked to study together with their friends and classmates which they cannot do during online and hybrid classes. Anytime they can approach their professor about the lessons, communication with their professors and classmates is much easier for them.

Teaching Strategies were used by the instructor to help the students with their challenges.

During Online Classes:

Due to the COVID-19 Pandemic, there are a lot of changes and challenges were encountered especially in the mode of instruction in teaching Mathematics. Mathematics subjects were very hard to teach traditionally and due to the pandemic, the instructors suddenly needed to teach it through online classes. However, the Philippines was also known to have a poor internet connection and this is a problem not only for the students but also the

instructors. With this, the strategies employed by their instructors during the conduct of online classes, the instructor records the class and the recorded video of the class is sent to the students so that the students who could not attend the online classes due to internet connectivity and unavailable devices could rewatch the lessons anytime. Also, the instructor sends the PowerPoint presentation of the lesson and a soft copy of the hand-outs with provided solutions to the math problems. With these strategies, the students can catch up easily on their missed lessons in mathematics because if there are some parts of the lessons that the students cannot understand they can easily rewind the video-recorded presentation. Sometimes if the majority of the classes cannot attend the online class the instructor is provided a video-recorded lesson.

During Hybrid Classes:

Some of the students' challenges in the online classes were addressed efficiently. However, the students' challenges during the hybrid classes, the instructor has no control over the schedule of online and face-to-face schedules the instructor just follows the schedule provided by the university. But to address the problems of the students in terms of the sudden changes in the schedule of face-to-face and online classes.

The best strategy that the instructor employed and appreciated by the students was that All lessons were conducted online which allows recording of classes and the recorded video was sent to the students and gave time for other students who could not attend the online class to watch the lessons. Then during the face-to-face classes, the instructor just recalls the lessons conducted in the online classes.

Also, if the students have some clarifications or questions about the lessons can address this with the class. Also, the instructor and students agreed that the submission of all outputs, activities, or tasks would be done face-to-face so that no students would have a hard time uploading the outputs, activities, or tasks online.

During Face-to-Face Classes:

It is really important to address all the students' challenges they encounter due to some educational transition. That's why many teaching strategies in teaching Mathematics were applied because during online and hybrid classes some of the students had already adopted the strategies of the instructor by providing the video-recorded presentation of the lesson. The problem encountered by the students during face-to-face classes that they cannot rewatch, rewind, or record the lessons was discussed by their instructor. To solve these challenges the instructor still provides some video-presentation of the lesson that the students can watch and also, they have provided some instructional materials which they can use to review and recall all the lessons. So that, even if the students cannot attend class regularly, they can catch up to the lessons easily.

Teaching strategies are critical in mathematics education because they significantly impact students' understanding, engagement, and retention of mathematical concepts. Effective teaching methods can increase mathematics' relevance, appeal, and accessibility, all of which are critical for fostering students' logical thinking and problem-solving abilities. The need of diversified education in meeting students' diverse needs is emphasized by Tomlinson's (2001) study. By tailoring their lesson to each student's needs, teachers can enhance their students' understanding and performance in mathematics. This enables them to offer the appropriate challenges and support to every student.

Conclusion

The conclusions directly address based on the result that anchored on the objectives of the study, comparing performance across instructional modalities and investigating its challenges and strategies.

The findings implies that students' academic performance in mathematics is more strongly influenced by the effectiveness of instructional strategies than by the mode of delivery alone. Active communication, participation, and collaboration between mathematics teachers and students were found to significantly enhance student outcomes. These results directly address the study's objective of identifying the key factors that support student success in

mathematics, demonstrating that instructional quality and interaction play a critical role in academic achievement, regardless of whether classes are conducted in the three instructional modalities such as online, hybrid, or face-to-face.

It implies that the technological ability of mathematics teacher shows an important factor in addressing all the challenges and difficulties associated between online and hybrid classes. Attending different training for instructional and digital technologies can improve teaching strategies to help students overcome their learning difficulties. The institution can foster higher achievement and sustained engagement in mathematics, ensuring that students are better prepared to succeed in a variety of learning contexts by strengthening engagement between students and mathematics teachers and providing targeted professional development.

This study also addresses the gap concerning students' experiences in different instructional modalities such as online, hybrid, or face-to-face. It highlights that instructional quality and interaction are critical components of student success, regardless of its modality. Future research may consider experimental or quasi-experimental designs with controlled groups to better determine causal effects of instructional modalities. Also, developing a validated instrument to quantify students' challenges and correlating these with academic performance may also provide stronger empirical support. These insights can guide mathematics teachers and curriculum designers in developing flexible yet effective learning environments that promote equitable access and improved student outcomes.

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