

Post-Pandemic Self-Concept and Challenges of Mathematics in the Modern World Students in a Flexible Learning Modality

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ABSTRACT

This study explored the academic self-concept and learning challenges experienced by 409 college students enrolled in Mathematics in the Modern World under a flexible learning modality at a private university during the second semester of academic year 2021–2022. Using a descriptive research design, the study examined student-related factors influencing their online learning experiences, including access to digital devices, availability of personal learning space, internet connectivity, and perceptions of online mathematics learning. Data were gathered through a survey questionnaire administered via Microsoft Forms and analyzed using frequency counts, mean, and standard deviation. The results showed that most students were still adapting to online learning and had primarily used Microsoft Teams and Moodlerooms as their learning platforms. The majority indicated that they had no siblings attending online classes at the same time, while those with siblings generally had access to personal devices. However, some students faced difficulties because they did not own devices and had to borrow equipment during learning sessions. Others experienced challenges due to limited study areas at home, which sometimes caused distractions and inconvenience. Despite these concerns, students maintained a positive academic self-concept, demonstrating confidence in achieving good grades, understanding mathematics lessons, and developing continued interest in the subject. They also recognized that online learning provided greater flexibility, independence, and control over their learning processes, contributing to increased motivation and engagement. The study recommends strengthening parental support for conducive home learning environments and promoting the effective use of Learning Management Systems to encourage student autonomy, engagement, and academic success in mathematics.

Keywords: Self-concept, Mathematics in the Modern World, Flexible Learning, Online Learning, Learning Management System

INTRODUCTION

In recent years, the landscape of education has undergone a dramatic transformation driven by the worldwide crisis that brought significant changes to the educational system, including the rapid adoption of new learning modalities such as online, modular, blended, and distance learning. During the COVID-19 pandemic, however, the term flexible learning was also commonly discussed alongside or as an umbrella for said learning modalities.

In the Philippines, the Commission on Higher Education (CHED) defines flexible learning as a learner-centered approach to teaching and learning that enables institutions to design and deliver educational programs responsive to learners' diverse needs by providing flexibility in the place, pace, process, and products through appropriate combinations of digital and non-digital instruction modalities [5]. The shift to flexible learning, in particular, has posed unique challenges and opportunities for students enrolled in mathematics, where conceptual understanding and problem-solving skills are fundamental. Post-pandemic, students' self-concept in mathematics or how students perceive their abilities in mathematics, has emerged as a factor of their academic engagement and achievement. Self-concept shapes the interpretation of life experiences and influences the perception of the

world. It plays a crucial role in guiding emotions, behaviors, values, and attitudes. A strong and positive self-concept fosters healthy and constructive thoughts, feelings, and actions [11].

Academic self-concept refers to students' self-perceptions of their academic abilities in specific domains, such as mathematics [10]. According to [8], a student's mathematics self-concept is influenced by their confidence in understanding new mathematical topics, achieving high performance, or solving problems successfully.

Moreover, [7] posited that there is a relationship between mathematics achievement and academic self-concept. They found evidence of bidirectional effects, with higher math achievement predicting higher academic self-concept predicting higher math achievement over time. According to [9], understanding students' academic self-concept in online learning environments is crucial for designing effective instructional strategies and support mechanisms, and hence, the importance of how students perceive their math learning abilities and interests. While prior works like the study of [2] and [6] deal with barriers to online learning, mathematics self-concept in the context of online learning is not that widely investigated, hence this study.

This study aimed to provide insights into students' mathematics self-concept and the challenges they encounter. It is primarily aligned with the United Nations (UN) Sustainable Development Goal (SDG) 4: Quality Education, as it examines students' learning experiences, academic self-concept, and the challenges of studying mathematics through a flexible learning modality in the post-pandemic context. The findings may inform policies and instructional practices that enhance educational quality, foster inclusive learning environments, and support student success in post-pandemic education.

METHODOLOGY

This study employed a quantitative research approach using a descriptive research design to examine the academic online learning self-concept in Mathematics in the Modern World among college students. A descriptive research design was considered appropriate because the study aimed to describe the existing level of students' mathematics self-concept in an online learning environment without manipulating any variables. Given the limited empirical evidence on students' online learning self-concept within the institutional context, the study also adopted an exploratory perspective by generating baseline information that may serve as a foundation for future research and educational interventions.

A total of 409 college students enrolled in the Mathematics in the Modern World course at a private university during the second semester of academic year 2021–2022 participated in the study. Purposive sampling was employed to select the participants. This sampling technique was chosen because the study specifically targeted students who met the predetermined inclusion criteria, particularly those officially enrolled in the course during the specified academic period. By selecting respondents who possessed the characteristics relevant to the research objectives, purposive sampling ensured that the data gathered were appropriate for addressing the research questions.

Data were collected using an adapted questionnaire based on previously validated instruments measuring mathematics self-concept. Prior to its administration, the questionnaire underwent expert validation to establish its content validity and ensure that the items were appropriate for the study's objectives and context. The instrument consisted of two sections. The first section gathered the respondents' demographic information, while the second assessed their mathematics self-concept in the context of online learning. The questionnaire was administered electronically through Microsoft Forms, providing a convenient and accessible platform for data collection while ensuring compliance with institutional guidelines and public health protocols implemented during the conduct of the study.

The collected data were analyzed using descriptive statistical techniques. Frequency and percentage distributions were used to summarize the respondents' demographic characteristics, while the mean and standard deviation were computed to determine the level and variability of students' mathematics self-concept in online learning. These descriptive statistics provided a comprehensive overview of the respondents' characteristics and perceptions, consistent with the descriptive and exploratory objectives of the study.

RESULTS AND DISCUSSION

Profile of the respondents in terms of age, gender, year level, gross monthly family income, use of Learning Management System (LMS) through Microsoft Teams (MS Teams) and Moodlerooms, number of siblings, and device-sharing during online class

The average age of the 409 respondents is 19.53 with a standard deviation of 1.51. Most of them are in the age range of 18 to 36. Majority of the participants are female, enrolled in the College of International Tourism and Hospitality Management (CITHM) and are freshmen. Their Gross Monthly Family Income (GMFI) ranged from PhP 10,500 to PhP 42,000. The respondents predominantly began using LMS through MS Teams and Moodlerooms during the first semester of the academic year 2021-2022. Most respondents reported having no siblings and were currently enrolled in online classes. Those with siblings generally had their own devices for use during online sessions. However, some respondents relied on borrowed devices, and a few reported having no device available at all.

Table 1. Student-related factors in terms of device ownership, personal physical learning space access, internet connection, and perception of mathematics online learning

Student-related factors	f	%
<i>Device ownership</i>		
One device	111	27.1
Two devices	260	63.6
Three or more devices	38	9.3
<i>Personal physical learning space access</i>		
With personal space	305	74.6
Without personal space	104	25.4
<i>Internet connection</i>		
Very slow	7	1.7
Slow	22	5.4
Sometimes fast, sometimes slow	334	81.7
Fast	40	9.8
Very fast	6	1.5
<i>Perception of mathematics online learning</i>		
Harder than face-to-face	66	16.1
Easier than face-to-face	79	19.3
About the same level of difficulty with face-to-face	111	27.1
About the same level of ease with face-to-face	85	20.8
Unsure/I cannot tell	68	16.6

From the table, results show that 371 (90.7%) of the student-respondents own 1 or 2 devices. Three hundred five (305) or almost 75% have personal space during online sessions. About 29 (7.1%) have slow or very slow internet connection while 81.7% experience intermittent internet connection during online class. Majority of the respondents perceived that online learning in mathematics differs in terms of difficulty or ease compared to face-to-face learning, aligning with the findings of [4]. The findings of this study indicate that most learners perceive mathematics delivered through an online learning platform to be more challenging than mathematics taught in a traditional face-to-face instructional setting. This perception emerged within the context of learners' mathematics self-concept and the challenges associated with the flexible learning modality.

Table 2. Mathematics self-concept of students in terms of mathematical ability

STATEMENTS	$\bar{x}$	SD	QD
I can get good grades on my tests in online learning.	3.76	0.80	True
I can understand the lessons easily.	3.23	0.87	Unsure
I can submit the activities easily.	3.66	0.92	True

I can do well overall in my subjects.	3.42	0.85	Unsure
I can attend the classes easily.	3.70	0.97	True
I can do the assignments easily.	3.53	0.84	True
I can help my classmates with our assignments.	3.40	0.97	Unsure
I can easily recall what I have learnt.	3.36	0.97	Unsure
I can easily finish my subjects in online learning than face-to- face.	3.34	1.05	Unsure
I can perform better than my classmates.	2.81	0.91	Unsure
I can perform better than my schoolmates.	2.80	0.91	Unsure
I can pass my subjects.	3.91	0.71	True
It takes lesser effort to study for the exam/quizzes online.	3.00	0.99	Unsure
It takes lesser effort to understand the topics in an online class.	2.89	0.95	Unsure
It takes lesser effort to do assignments in online learning.	3.15	0.95	Unsure
Overall, it takes lesser effort to study in online learning.	2.97	1.00	Unsure
Overall	3.31	0.92	Unsure

The results revealed that students' self-concept in terms of Mathematical Ability shows different outcomes regarding their experiences with online learning. Students agree that they can get good grades with a mean of 3.76 with standard deviation of 0.80, submit activities easily with a mean of 3.66 and a standard deviation of 0.92, attend classes (Mean: 3.70, SD: 0.97), and pass subjects (Mean: 3.91, SD: 0.71). However, they are uncertain about understanding lessons (Mean: 3.23, SD: 0.87), recalling what they have learned (Mean: 3.36, SD: 0.97), and performing better than peers (Mean: 2.80–2.81). Efforts to study and understand topics also remain unclear (Mean: 2.89–3.15). Overall, with a mean of 3.31 and a standard deviation of 0.92, students find online learning beneficial for accessibility and task completion but struggle with comprehension and relative performance. The shift toward flexible learning modality has redefined how students engage with education, particularly in mathematics. Changes such as this have brought both opportunities and challenges, especially in a subject that demands strong problem-solving skills and conceptual understanding [3].

Table 3. Mathematics self-concept of students in terms of mathematics interest

STATEMENTS	$\bar{x}$	SD	QD
It takes lesser effort to be on time to attend online classes.	3.53	0.99	True
It takes lesser effort to ask questions to teachers in an online learning.	3.18	0.96	Unsure
It takes lesser effort to collaborate with my classmates online.	2.93	1.04	Unsure
I will be more interested to learn.	3.52	0.97	True
Online learning is more enjoyable than face-to-face.	2.57	1.14	Unsure
Online materials are interesting to learn.	3.34	0.92	Unsure
There is no dull moment when I am in an online class.	2.69	1.08	Unsure
I feel excited when attending online lectures.	3.05	0.99	Unsure
Overall	3.10	1.01	Unsure

Results on Mathematical Interest reflect mixed perceptions of students' engagement with online learning. While students agree that attending online classes on time is easier (Mean: 3.53, SD: 0.99) and they are generally interested in learning (Mean: 3.52, SD: 0.97), they remain uncertain about other aspects. Asking questions (Mean: 3.18, SD: 0.96), collaborating with classmates (Mean: 2.93, SD: 1.04), and finding online materials interesting (Mean: 3.34, SD: 0.92) show inconsistent responses. Students also feel unsure about enjoying online learning compared to face-to-face (Mean: 2.57, SD: 1.14) and maintaining excitement during lectures (Mean: 3.05, SD: 0.99). The overall mean of 3.10 with a standard deviation of 1.01 indicates moderate interest, but the high variability suggests diverse experiences, highlighting that while some students find online learning engaging, others struggle with motivation and enjoyment. These findings align with the research of [1], which highlighted the variation in students' learning experiences during online learning. It noted that while some students thrived due to the flexibility of online platforms, others faced challenges such as decreased motivation, distractions, and difficulties in staying engaged. Similarly, [12] revealed that while online platforms enhance accessibility and allow for personalized pacing, students' levels of engagement and motivation vary widely.

Factors such as technological proficiency, interaction with peers, and the clarity of materials contribute to these differences.

CONCLUSIONS

Based on the findings, the following conclusions were formulated:

1. Majority of the students are young, with ages ranging from 18 to 36 years, and an average age of 19.53 years. The respondents are predominantly female, mostly from the College of International Tourism and Hospitality Management (CITHM) and are mostly freshmen. Their families' monthly income ranges between PhP 10,500 to PhP 42,000. Most of the respondents used MS Teams and Moodlerooms online. Additionally, many respondents do not have siblings currently enrolled in online classes, and those who do typically have their own devices. However, some students still rely on borrowed devices or lack access to their own, indicating variability in access to resources during online learning. Some online synchronous learners have physical learning space limitations which make learning inconvenient. Somehow, this has contributed to their low academic self-concept.
2. Most student-respondents own one or two devices and have access to personal space during online sessions. However, some experience slow or very slow internet connections, while many face intermittent connectivity issues during online synchronous classes. Some respondents perceive online learning in mathematics to be of similar difficulty or ease compared to face-to-face learning.
3. The results suggest that while students show positive perceptions of the accessibility and task completion aspects of online learning, they exhibit mixed feelings about their mathematical ability and interest. Although they feel confident in certain areas, such as passing subjects and attending classes, they express uncertainty regarding their comprehension, performance, and engagement. The varied responses indicate that while online learning offers flexibility and convenience, it may require improvements in fostering consistent understanding and maintaining student Mathematics ability and interest.

RECOMMENDATIONS

1. Faculty members (or the university) may send letters to parents or guardians about new learning modalities and orient them with the importance of providing a conducive home environment particularly when it comes to online learning.
2. The institution may continuously provide an LMS that supports the needs of Mathematics in the Modern World students learning online, while also allowing the testing of platforms beyond MS Teams and Moodlerooms. This will encourage student autonomy, engagement, and academic success in mathematics.
3. Future research may build on this exploratory study by examining students' self-concept across different subject areas and learning modalities. The findings of this study and related research may also inform educational policies and instructional practices that enhance educational quality, promote inclusive learning environments, and support student success in the post-pandemic educational landscape.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Suggested Data Availability Statements are available in section “MDPI Research Data Policies” at <https://www.mdpi.com/ethics>.

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