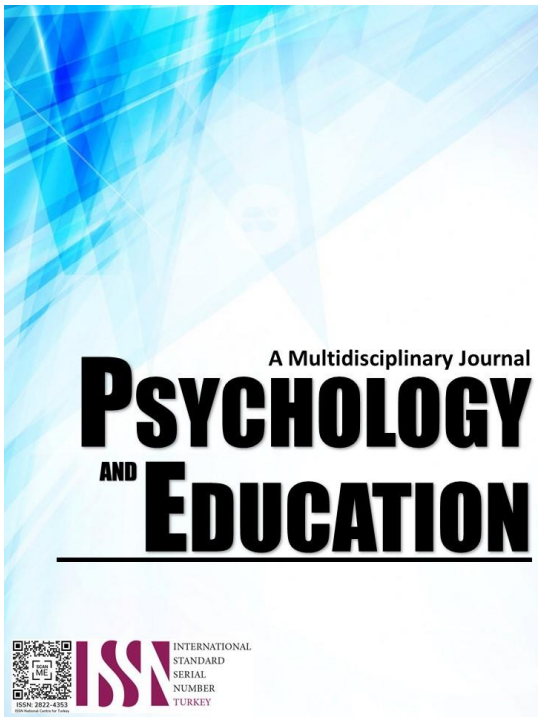
MATHEMATICS SELF-CONCEPT AND LEARNING FACTORS IN RELATION TO ACADEMIC PERFORMANCE



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Research Article

Mathematics Self-Concept and Learning Factors in Relation to Academic Performance

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Abstract

This study sought to determine the relationship between the level of mathematics self-concept, learning factors and academic performance in blended learning modality. In this study, a mixed method using an embedded design was employed to collect both quantitative and qualitative data, with the latter being used to supplement the former. The results of the study revealed that the level of mathematics self-concept of the participants was moderate, the level of the learning factors in blended learning was moderate, and the academic performance in general mathematics was outstanding. However, when results were analyzed per item, findings revealed that during the blended learning, students had trouble understanding and remembering what they learned in mathematics. This was corroborated by the key informants' responses during the interview. Additionally, the findings showed that in blended learning, connectivity and personal space were crucial considerations to make when the participants were studying away from noise and distractions as likewise confirmed by the key informants in their responses. Results also revealed that no significant difference exists in mathematics self-concept and learning factors when the participants were grouped by sex, strand, and school of origin. In terms of academic performance, findings revealed that no significant difference exists when the participants were grouped according to school of origin but a significant difference exists when they were grouped according to sex and strand. Additionally, it was found out that no significant relationship exists between mathematics self-concept, learning factors, and academic performance. The researchers concluded that there is a need to conduct diagnostic test in mathematics to specifically determine the strength and weaknesses of the participants as gleaned from the contradicting quantitative and qualitative findings of the study. Thus, this study suggests that teachers regularly carry out formative assessments and closely monitor students' learning and performance through in-person and online discussions.

Keywords: *mathematics self-concept, learning factors, academic performance, blended learning*

Introduction

The instantaneous occurrence of the COVID-19 pandemic greatly affected different sectors, including the education sector, as face-to-face instruction was strictly prohibited. This pandemic has disrupted education systems globally, affecting the most vulnerable learners the hardest (UNESCO, 2021).

Accordingly, it was revealed that there will be more likely a drop in the mathematics performance of the secondary school students in the national examination if ever the pandemic is not contained in the earliest time possible considering the abruptly disrupted school calendar brought about by the premature school closure (Sintema, 2020). Students' interest in learning Mathematics already declines as they reach adolescence since they find concepts in the latter to be hardly applicable in the real world (Galindo & Newton, 2017).

Along this line, Mathematics learning has been a struggle in the academic realm. Specifically, in the Philippines, it was identified as one of the subjects considered hardest to learn, considering the findings of the Program for International Student Assessment (PISA) 2018, which revealed that out of 80 countries, representative Filipinos ranked 78th in Mathematics. Indeed, Filipinos' Math performance is deteriorating (Silk et al., 2017).

Consequently, DepEd Order No. 012 Series of 2020, which is the Adoption of the Basic Education Learning Continuity Plan for School Year 2020-2021 has been released by the Department of Education. This provides access to education through necessary and available platforms (either online or offline). The greater challenge, however, is left to those who can hardly comprehend content through distance education (Mateo, 2020) due to the shift from a classroom environment to a home learning environment (Baticulon et al., 2021). Here in Kabankalan Catholic College (KCC), mathematics teachers observed that many of their low performing students before the pandemic had shown improvement in their grades during the implementation of the blended learning modality. However, during online discussions, these same students hardly participated actively in the discussions of the lessons.

Along this line, technological, personal, institutional, and community barriers were identified in distance learning in during the COVID-19 pandemic (Baticulon

et al., 2021; Fabito et al., 2021) but the relationship of these restrictions to the mathematics self-concept and learning factors of the students in a blended learning modality has not been fully determined particularly in KCC. It was on this premise that the researchers conducted this study.

Research Questions

The study was conducted to determine whether there was a difference in mathematics self-concept and learning factors in blended learning modality in relation to academic performance. Specific questions that the researchers aimed to answer were the following:

1. What is the demographic profile of the participants when grouped according to:
   1.1. sex;
   1.2. strand; and
   1.3. school of origin?
2. What is the level of mathematics self-concept of the participants as a whole and in terms of:
   2.1. ;earning;
   2.2. organization;
   2.3. dynamics?
3. What are the learning factors of students in blended learning modality as a whole and in terms of:
   3.1. accessibility;
   3.2. personal space; and
   3.3. learning autonomy?
4. What is the academic performance in mathematics of the participants as a whole and when grouped according to:
   4.1. sex;
   4.2. strand; and
   4.3. school of origin?
5. Is there a significant difference in the level of mathematics self-concept of the participants when grouped according to:
   5.1. sex;
   5.2. strand; and
   5.3. school of origin?
6. Is there a significant difference in the learning factors in blended learning modality when grouped according to:
   6.1. sex;
   6.2. strand; and
   6.3. school of origin?
7. Is there a significant difference in the academic performance in General Mathematics of the participants when grouped according to:
   7.1. sex;
   7.2. strand; and
   7.3. school of origin?
8. Is there a significant relationship between the mathematics self-concept, learning factors of students in blended learning modality and their academic performance in General Mathematics?
9. What are the challenges of the key informants during the blended learning approach?

Methodology

The mixed method embedded design was used in this study. In this method, the researchers gathered quantitative data and support the findings with the qualitative data gathered in an interview conducted with key informants.

Creswell and Clark (2010) described embedded mixed method as a research design where researchers combined the collection and analysis of both quantitative and qualitative data with the latter providing support and having a secondary role to the quantitative findings (Yu & Kazanchi, 2017).

The participants of the study were the 217 Grade 11 students officially enrolled in Kabankalan Catholic College with academic strands in ABM, HUMSS, and STEM for the quantitative part. There were eight (8) participants for the qualitative part, which were two (2) in each strand and two (2) Mathematics teachers in Grade 11. The researchers used stratified random sampling in determining the number of students. This study was conducted at Kabankalan Catholic College located at Guanzon Street, Brgy. 1, Kabankalan City, Negros Occidental.

This study used a survey questionnaire in determining the mathematics self-concept and learning factors in blended learning modality in relation to academic performance.

McLeod (2018) stated that a questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. Questionnaires are similar to written interviews in that they collect information. They can be done in person, over the phone, on the computer, or by mail.

The questionnaire was adapted from the studies of Peteros et al. (2019) entitled Factors Affecting Mathematics Performance of Junior High School

Students and Bringula et al. (2021) entitled Mathematics Self-Concept and Challenges of Learners in an Online Learning Environment during COVID-19 Pandemic. The survey questionnaire was made up of five (5) parts. The first part of the questionnaire was the consent form of the participants allowing the researchers to get the grades in General Mathematics from the respective advisers in compliance to the Privacy Act, the names of the participants were numbered. National Privacy Commission (2020) mentioned that an announcement or posting involving personal data, such as the result of grades, must be viewable only by its intended recipient/s. The second part contained the demographic profile of the participants, which included the name, strand, sex, and school of origin. On the third part, the mathematics self-concept of students in blended learning modality included learning, organization, and dynamics. The fourth part contained the students' learning factors in blended learning, which included the accessibility on device ownership and modes of blended learning, personal space for blended learning, and learning autonomy.

On the qualitative part, the researchers used an open-ended questionnaire in a written format. The last part were the open-ended questions that comprised of three (3) questions for the students and three (3) for the teachers that determine the mathematics self-concept and learning factors in blended learning modality.

In gathering the data, the following procedures were observed: First, the researchers wrote the following letters addressed to the High School Principal: permit to conduct the study, for reliability test, conduct the survey and gathering the grades. Second, a letter of permission addressed to the School Registrar to get the master list of the grade 11 students. Third, a letter of request for validation were forwarded to the three (3) experts in the field of Education. Fourth, a pilot testing was done to twenty (20) students from different academic strands (ABM, HUMSS, and STEM) to test and refine the procedures of the study. Fifth, the survey was conducted through Google form. Sixth, statistical analyses were formulated with the help of the research adviser and statistician. Seventh, the interview was conducted to the eight participants (two Mathematics Teachers and six students) to validate the answers from the survey.

In the analysis of data, appropriate statistical tools were used on the basis of the specific objectives and hypotheses that are set forth earlier in this study. For problem number 1, frequency count and percentage were used. According to Geert van den Berg (2022), frequency distribution tells how frequencies are distributed over values.

For problem numbers 2, 3, and 4, mean was used. Bhandari (2022), stated that mean, different from the geometric mean of a dataset is the sum of all values divided by the total number of values. It is also known as the average and is the most widely used measure of central tendency.

For problem numbers 5, 6, and 7, t-test and one-way ANOVA, were used. T-test is a statistical test that is used to compare the means of two groups. It is often used in hypothesis testing to determine whether a process or treatment actually has an effect on the population of interest, or whether two groups are different from one another (Bevans, 2020). Mackenzie (2021) stated that one-way ANOVA is a type of statistical test that compares the variance in the group means within a sample whilst considering only one independent variable or factor. It is a hypothesis-based test, which means it'll look at several mutually exclusive explanations about our data.

For problem number 8, Pearson Correlation was used. According to Pathak (2020), Pearson's Correlation Coefficient is also referred to as Pearson's r, the Pearson product-moment correlation coefficient (PPMCC), or bivariate correlation. It is a metric for determining the linear relationship between two variables.

The researchers utilized a 5-point rating scale to respond to the questions on the mathematics self-concept and learning factors in relation to academic performance of Grade 11 students of Kabankalan Catholic College following the interpretation: 4.21-5.00 which means very high; 3.41-4.20 interpeted as high; 2.61-3.40 means moderate; 1.81-2.60 interpreted as low; 1.00-1.80 interpreted as very low. For the academic performance of the students, the researchers used the DepEd Order 08 s2015 following the interpretation: 90-100 as outstanding; 85-89 as very satisfactory; 80-84 as satisfactory; 75-79 as fairly satisfactory; and below 75 means "did not meet expectation".

Results and Discussion

Table 1. *Demographic Profile of the Participants*

	Profile	Frequency	Percent
Sex			
	Male	107	49.3
	Female	110	50.7
Strand			
	ABM	28	12.9
	HUMSS	67	30.9
	STEM	122	56.2
School of Origin			
	Public	66	30.4
	Private	151	69.6

Table 1 shows the demographic profile of the participants. When grouped according to sex, the table reveals that 107, or 49.3%, were male and 110, or 50.7%, were female. This shows that there were more female participants in the study than male. In contrast to this, according to the Philippines Statistics Authority (2022), the population of males is 56.3 million more than that of females, which is 55.3 million.

Moreover, when grouped according to strand, the table indicates that 28 or 12.9% were the ABM, 67 or 30.9% were the HUMSS, and 122 or 56.2% were the STEM. It implies that more STEM students were interested in math and science and courses offered in college are more aligned in this strand. According Suero and Fabro (2017), the stem strand was chosen by the majority of grade 11 students over the many other tracks and strands available in the K-12 curriculum. They believed that taking this course would help them achieve the best possible future career. However, not all students had the freedom to choose what they wanted for a variety of reasons, including the fact that their parents required them to take this course and that slots in other strands are limited.

Furthermore, when grouped according to school of origin, the table shows that 66 students, or 30.4%, came from public schools while 151 students, or 69.6%, came from private schools. This indicates that students from private schools outnumbered those from public schools in view of the fact that the COVID-19 pandemic drastically disrupted the functioning of public schools, potentially changing the relative appeal of alternatives such as homeschooling and private schools (Musaddiq et al., 2021).

Table 2.1 *Mathematics Self-Concept of the Participants in terms of Learning*

Indicators	Mean	Interpretation
I learned Mathematics quickly in the new normal.	***2.81***	***Moderate***
In my Mathematics class, I understood even the most challenging work.	2.88	Moderate
I am capable of learning Mathematics independently.	3.00	Moderate
I am good in understanding mathematical concepts.	2.97	Moderate
I am capable of making a good grade in Mathematics.	3.31	Moderate
I do extra work to learn Mathematics.	3.14	Moderate
Learning Mathematics gives me meaning to learn activities.	***3.41***	***High***
Even if the work in Mathematics is hard, I can learn it.	3.26	Moderate
Every question in Mathematics is answerable.	3.15	Moderate
I am sure I can learn the skills taught in Mathematics class well.	3.29	Moderate
Overall Mean	**3.12**	**Moderate**

Table 2.1 presents the mathematics self-concept in terms of learning. The table reveals that grade 11 students have positive mathematics self-concept and learning mathematics for them gives meaning to learn activities with a mean of 3.41 which is interpreted as "high". However, the result also revealed that the students have difficulty learning Mathematics quickly in the new normal, with a mean of 2.81 interpreted as "moderate".

According to key informant 1, "In face-to-face learning, I can say that I learned so many things and had a deeper understanding, unlike in blended learning, where it becomes so hard for me to understand even just one lesson. I am more motivated and inspired by face-to-face learning than blended learning. I experienced so many challenges in a blended learning class. I became too lazy and procrastinated a lot in answering my schoolworks. I pressured myself too much because I worked well under pressure."

It implies that students are aware that mathematics is a helpful subject in learning. However, in the new normal, students find it hard to learn mathematics quickly since there is an absence of a teacher to teach the subject. In the study of Ariyanti and Santoso (2022), prior to online learning, the average student's positive attitude toward Mathematics was greater than before online learning.

Table 2.2 *Mathematics Self-Concept of the Participants in terms of Organization*

Indicators	Mean	Interpretation
I usually do well in Mathematics.	3.02	Moderate
I am more enthusiastic in Mathematics than for a significant number of my schoolmates.	2.82	Moderate
I have dependably accepted that Mathematics is a standout subject amongst my other subjects.	3.10	Moderate
I get good marks in Mathematics.	3.12	Moderate
Mathematics is an easy subject to pass.	***2.53***	***Low***
Mathematics is worth passing well.	3.50	High
Mathematics helps to find a new way of finding things.	***3.63***	***High***
When I do Math, I feel confident that I have done it correctly.	3.09	Moderate
It takes me to comprehend mathematical ideas faster than the average individual.	2.96	Moderate
When I have difficulties with Math, I know I can handle them if I try.	3.41	High
Overall Mean	**3.12**	**Moderate**

Table 2.2 shows the mathematics self-concept in terms of organization. The table reveals that students have moderate mathematics self-concept in terms of organization with an overall mean of 3.12. Moreover, the students perceived that Mathematics helps to find a new way of finding things with a mean of 3.63 interpretated as "high". In contrast, students find Mathematics as a subject not easy to pass with the mean of 2.53 and interpreted as "low". According to key informant 2, "I find math as a very difficult subject. Many said that it is easy if you focus on it. I learned a bit on solving problems."

This implies that students know that through math they can learn new things, but it also reveals that this subject is one that students find difficult to take and succeed in. Thus, the students have a high regard upon handling problem in mathematics and able to do well.

In the six-week pilot test of synchronous online learning, students' motivation and sense of self-efficacy in Mathematics significantly decreased, according to Mamolo's report from the year 2022. Therefore, learning components and how students are exposed to, stimulated by, act upon, and respond to their learning process affect academic success.

Table 2.3. Mathematics Self-Concept of the Participants in terms of Dynamics

Indicators	Mean	Interpretation
I can practically do all the work in Mathematics class if I do not give up.	3.53	High
Mathematics improves my understanding of other subjects.	3.30	Moderate
Mathematics improves my learning and retention capacities.	3.35	Moderate
I feel delighted when answering questions in Mathematics.	3.21	Moderate
Mathematics is suitable for all students.	3.27	Moderate
Mathematics encourages me to apply detailed steps to solve my problems.	3.40	Moderate
Mathematics makes me think fast.	3.35	Moderate
My present knowledge of mathematical concept is high.	***2.88***	***Moderate***
Mathematics is essential in the future.	***3.67***	***High***
I am comfortable in Mathematics.	3.07	Moderate
Overall Mean	**3.30**	**Moderate**

Table 2.3 presents the mathematics self-concept in terms of dynamics. The table reveals that students are moderately active and sometimes involved in what they are learning in terms of dynamics as shown with a mean of 3.30. Furthermore, students agreed that Mathematics is essential in the future with the mean of 3.67 interpreted as "high" however the present knowledge of mathematical self- concept of students transcribed in the data is moderate with the mean of 2.88.

According to key informant 3, "To be honest, my learning in these blended learning classes is very low because sometimes I can not understand the topic." Likewise, key informant 4 stated that "It is hard for me because I am not good at math, but I am trying my best to solve the problems one by one." Furthermore, key informant 6 said, "With blended learning, I can learn on my own, but it is not enough to develop and learn more about the lesson because there is no teacher to explain."

It implies that students are able to think that Mathematics is an important subject in the future, but the perceived knowledge and skills of students in Mathematics are still lacking and need more support from teachers. Since it forms the foundation for fostering the students' learning interests, it is important to comprehend how students view themselves in relation to Mathematics (Masitoh & Firtriyani, 2018).

Table 2.4 *Mathematics Self-concept of the Participants as a Whole*

Variable	Mean	Interpretation
Learning	3.12	Moderate
Organization	3.12	Moderate
Dynamics	3.30	Moderate
Mathematics Self-Concept		
Overall Mean	**3.18**	**Moderate**

The participants' collective self-concept in mathematics is displayed in Table 2.4. The table shows that learning, organization, and dynamics are interpreted as "moderate" with means of 3.12, 3.12, and 3.30 respectively. Whereas, the participants' overall mean on mathematics self-concept is 3.18 interpreted as "moderate".

According to key informant 4, "I am trying my best to accomplish my lessons, activities, and especially my performance task." However, according to key informant 1, "I am the type of learner who finds it too hard to understand a lesson, especially in Mathematics."

The students were able to understand how important Mathematics is and its use in everyday life and in the future. However, the students find it hard to study in times of a pandemic and grasp ideas in Mathematics. This report illustrates how poorly and significantly the COVID-19 pandemic has impacted students' academic achievement, according to a later study by Moliner, Alegre, and Valentin (2022). It also shows how this tendency can be attributed to student disengagement, boredom, and lack of motivation, as well as changes in educational environments.

Table 3.1 *Learning Factors of the Participants in terms of Accessibility*

Indicators	Mean	Interpretation
Complete PDFs as support materials are provided in the system.	3.41	High
Complete and clear information about the use of the digital tool is provided (e.g., messenger, email, Gmail, etc.).	3.53	High
I have devices available at home that I can use for blended learning.	3.38	Moderate
I have a good internet connection in my locality.	***2.98***	***Moderate***
I pass my activities, work, and responses through digital tools and other modes of delivery for easy access.	***3.55***	***High***
Overall Mean	**3.37**	**Moderate**

Table 3.1 shows the learning factors of the participants in terms of accessibility. The table reveals the students have a moderate access on the gadgets used during blended learning modality which has a mean of 3.37. Thus, the students had easy access in passing activities, work, and responses through digital tools and other modes of delivery having a mean of 3.55 interpreted as “high”. However, the internet connectivity had an impact on the learners as they do not have enough good internet connection as determined by the students, which has a mean of 2.98 interpreted as “moderate”.

According to key informant 6, "The internet connection is unstable in a blended learning class." In line with this, key informant 5 said that, "I experienced difficulties while taking my online class when the connection was poor." It implies that students were able to pass and gather information and copies of activities, but there were difficulties with the internet connection in their respective places.

The top educational issues in the Philippines in the new normal of learning, according to Child Hope Philippines (2021), are access to a stable internet connection, lack of participation in online learning and resources being left behind, and the difficulty of affording online resources for those who are less fortunate.

Table 3.2 *Learning Factors of the Participants in terms of Personal Space*

Indicators	Mean	Interpretation
I am responsible for my studies at home.	***3.58***	***High***
I am always prepared when there is an online consultation set by the teacher.	3.35	Moderate
I prepared myself physically, mentally, emotionally, and spiritually on answering the different tasks.	3.41	High
I have a spacious learning environment to answer my works.	***3.29***	***Moderate***
I always make sure my time is manageable.	3.44	High
Overall Mean	**3.41**	**High**

Table 3.2 shows the learning factors of the participants in terms of personal space. The table shows a high learning factor in personal space, which has an overall mean of 3.41. The students being responsible studying at home has a mean of 3.58 and is interpreted as “high”. However, in terms of space for their learning on answering works, this is the lowest as determined by the students, which has a mean of 3.29 interpreted as “moderate”. With this, according to key informant 3, "Sometimes I can not understand the lessons and there were distractions around." In support according to key informant 6, "I experienced not having a quiet place to study and I could not catch up on the lesson because the explanation was fast in the video and there were a lot of distractions like Facebook, Tiktok, Instagram, etc."

It implies that although students do their responsibility at home, the learning space is the problem in studying where there are lots of distractions and noises. Noise and other distractions may interfere with students' ability to learn online if they lack access to a private physical learning space (Baticulon et. al., 2021; Bringula et. al., 2021).

Table 3.3 *Learning Factors of the Participants in terms of Learning Autonomy*

Indicators	Mean	Interpretation
Learning Autonomy		
I can understand the topics well.	***3.04***	***Moderate***
I consult my teachers or my classmates for inquiries.	3.44	High
I rely on the lectures of my teachers or tutorials of my classmates and friends.	3.42	High
I do read any instructions given carefully.	***3.62***	***High***
I watch video tutorials or any other references to learn.	3.59	High
Overall Mean	**3.40**	**Moderate**

Table 3.3 shows the learning factors of the participants in terms of learning autonomy. The table reveals a

moderate learning factor in learning autonomy, which has an overall mean of 3.40. Students' careful reading of instruction has a mean of 3.62 and is interpreted as "high". In contrast, students find it hard to understand the topics in Mathematics, which is the lowest as determined by the mean of 3.04 and interpreted as "moderate".

According to key informant 1, "Even if I watched tutorial videos, I still find it too hard to understand the lessons." Key informant 2 agreed, stating that "I encountered many challenges during blended learning, one of those things is having a hard time learning." Moreover, key informant 4 confirmed that, "It was very difficult learning mathematics in a blended learning environment because no one taught me except myself."

It implies that students adhere to the instructions but struggle to comprehend the lessons and topics imparted to them due to the lack of the physical presence of a teacher. According to a study by Boelens, Wever, and Voet (2017), the four main issues that the design of blended learning environments carries with it are flexibility, encouraging interaction, supporting students' learning processes, and creating an affective learning environment.

Table 3.4 *Learning Factors of the Participants as a Whole*

Variable	Mean	Interpretation
Accessibility	3.37	Moderate
Personal Space	3.41	High
Learning Autonomy	3.40	Moderate
Learning Factors Overall Mean	**3.39**	**Moderate**

The overall learning factors of the participants is displayed in Table 3.4. The table shows that accessibility (Mean=3.37), learning autonomy (Mean=3.40), are interpreted as "moderate", whereas, personal space (Mean=3.41) is interpreted as "high". Overall, the learning factors have a mean of 3.39 interpreted as "moderate". As a result, the students were responsible in comprehending the directions given and were able to have a positive outcome on the module paraphernalia in both soft copy and hard copy. Contrarily, it was shown that factors impacting the learners that have a detrimental impact on students during blended learning include the personal space designated for learning at home and the slow internet connection.

According to key informant 2, "Blended learning was not always enjoyable, and it was really draining. The work was so overwhelming that I could not learn that much. Having physical contact with people while learning was very vital." In connection, other key informants were having trouble with connectivity. As they said: key informant 3: "I have experienced having a slow internet connection"; key informant 5: "I experienced difficulties while taking my online class when the connection was poor"; and key informant 6: "I experienced the unstable internet connection in a blended learning class. It implies that the students are having technological issues, and so as for the new learning environment, where there is a big difference from what was the usual classroom setting. The obstacles of blended learning include those related to instructional modes, seat time, course mode, learning spaces, suite of tools, evaluation, and support, according to the University of Wisconsin-Madison (2020).

Table 4.1 *Academic Performance in Mathematics of the Participants when Grouped According to Sex*

Sex	N	Mean	Std. Deviation	Interpretation
Male	107	90.05	3.74	Outstanding
Female	110	91.80	4.05	Outstanding

Table 4.1 displays the academic performance of the participants when grouped according to sex. There were 107 male participants and 110 female participants. The table also shows the means and standard deviations of male (Mean=90.05, SD=3.74) and female (Mean=91.80, SD=4.05), both interpreted as "outstanding". This means that male students excel in Mathematics, however female students excel higher which is evident in the mean.

In contrast, according to Armah, Akayuuri, and Armah (2021), there were statistically significant differences in the achievement of Mathematics between males and females, with the males attaining higher grades than their female counterparts.

Table 4.2 *Academic Performance in Mathematics of the Participants and when Grouped According to Strand*

Strand	N	Mean	Std. Deviation	Interpretation
ABM	28	89.50	3.29	Very Satisfactory
HUMSS	67	88.88	3.65	Very Satisfactory
STEM	122	92.39	3.70	Outstanding

Table 4.2 indicates the level of academic performance in Mathematics of the participants when grouped according to strand. ABM had 28 participants, HUMSS had 67 participants, and STEM had 122 participants, demonstrating that STEM had more participants compared to other strands.

On the table, the means and standard deviations are shown with ABM (Mean=89.50, SD=3.29), HUMSS (Mean=88.88, SD=3.65), both interpreted as "Very Satisfactory", whereas, STEM (Mean=92.39, SD=3.70) interpreted as "Outstanding".

Furthermore, STEM had the highest mean grade among the academic strands, owing to the fact that students with higher Mathematics self-efficacy and STEM career knowledge are more likely to choose a STEM career (Kaleva et al., 2019), which emphasizes problem-solving with real-world problems integrating many disciplines and other skills such as science, technology, Mathematics, and engineering (Wahono, Lin, & Chang, 2020).

Table 4.3 *Academic Performance in Mathematics of the Participants when Grouped According to School of Origin*

School of Origin	N	Mean	Std. Deviation	Interpretation
Public	66	90.45	4.11	Outstanding
Private	151	91.15	3.93	Outstanding

Table 4.3 indicates the level of academic performance in Mathematics of the participants when grouped according to school of origin. There were 66 participants coming from public schools and 151 participants came from private. This exhibits that there were more students coming from private schools than public schools. In addition, the result shows the means and standard deviations based from their school of origin. Those who came from private schools (Mean=91.15, SD=3.93) performs better than those who came from public schools (Mean=90.45, SD=4.11), both are interpreted as "Outstanding".

According to Hasson and Farnan (2018), the most recent National Assessment of Education Progress (NAEP) data conforms to the findings of other research in which private school students score better in almost all subjects, wherein 44% are at or above proficient in Mathematics.

Table 4.4 *Academic Performance in Mathematics of the Participants as a Whole*

Variable	Mean	Interpretation
Academic Performance As a Whole	90.94	Outstanding

Table 4.4 presents the academic performance of students in Mathematics as a whole. The table reveals that the participants had a mean grade of 90.94 which was interpreted as "Outstanding". This implies that the grade 11 students have excellent academic performance in Mathematics.

According to Teacher Informant 1, "Blended learning helped learners improve their sense of autonomy and responsibility and allowed facilitators to maintain learners' engagement and motivation. And also, it helped students increase their interactions, communication skills, self-confidence, self-awareness, as well as encourage discussion and collaboration not only with their lecturers but also with their peers and course materials, leading to an overall positive experience. "

Habaasa, Lillian, and Samson (2020) highlight that nearly all of the articles they analyzed cited instructional strategies, teacher attitudes, and students' attitudes toward Mathematics as important determinants. The idea that parents can have a favorable impact on their children's arithmetic performance, classroom climate, pupils' prior math achievement, and gender-related characteristics appeared to be consistent.

Table 5.1 *Difference in the Level of Mathematics Self-Concept of the Participants when Grouped According to Sex*

Sex	Mean	Standard Deviation	t-value	p-value	Decision	Result
Male	3.39	0.74	-0.26	0.79	Do not Reject Ho	Not significant
Female	3.42	0.78				

Table 5.1 presents the difference in the level of mathematical self-concept of the participants when grouped according to sex. At 0.05 level of significance, the result shows that there is no significant difference in the level of mathematics concept (p-value=0.79, t=-0.26) between male (mean=3.39, SD=0.74) and female (mean=3.42, SD=0.78). This implies that male and female students have the same level of self-concept in Mathematics.

However, Rodriguez et al. (2020) discovered that girls had fewer favorable views toward Mathematics than their male classmates, including poorer motivation, a lower perception of ability, and higher rates of anxiety, but the impact sizes were small in all situations. Along this line, the study of Okyere (2019) confirms that male students tend to have a higher estimation of their self-concept and achieve higher scores on the mathematics achievement test than female students.

Table 5.2 *Difference in the Level of Mathematics Self-Concept of the Participants when Grouped According to Strand*

Strand	Mean	Standard Deviation	F-value	p-value	Decision	Result
ABM	3.62	0.54	1.38	0.26	Do not Reject Ho	Not significant
HUMSS	3.39	0.88				
STEM	3.36	0.73				

Table 5.2 presents the difference in the level of Mathematics self-concept of the participants when grouped according to strand. At 0.05 level of significance, the result shows that there is no significant difference among the strands (p-value=0.26, F-value=1.38). This implies that the mathematics self-concept of students in the academic strands of ABM (mean=3.62, SD=0.54), HUMSS (mean=3.39, SD=0.88), and STEM (mean=3.36, SD=0.73) has no variation.

According to Masitoh and Firtriyani (2018), Mathematics self-concept and Mathematics self-efficacy (i.e., a belief in a student's ability to solve mathematical problems or tasks related to Mathematics) predicted Mathematics achievement. Thus, it is critical to comprehend students' Mathematics self-concepts since they act as a foundation for cultivating students' learning interests.

Table 5.3 *Difference in the Level of Mathematics Self-Concept of the Participants when Grouped According to School of Origin*

School of Origin	Mean	Standard Deviation	t-value	p-value	Decision	Result
Public	3.46	0.72	0.69	0.49	Do not Reject Ho	Not significant
Private	3.38	0.78				

Table 5.3 shows the difference in the level of Mathematics self-concept of the participants when grouped according to school of origin. At 0.05 level of significance, the result shows that there is no significant difference in the level of mathematics concept (p-value=0.49, t=0.69) between public (mean=3.46, SD=0.72) and private (mean=3.38, SD=0.78). This implies that the school of origin has no impact on the students' ratings of their skills, ability, enjoyment, and interest in Mathematics (Peteros et al., 2019), considering that the means of both public and private are almost similar. Okyere's (2019) research confirmed that school type has no significant effect on students' self-concept and Mathematics achievement.

Table 6.1 *Difference in the Level of Learning Factors of the Participants when Grouped According to Sex*

Sex	Mean	Standard Deviation	t-value	p-value	Decision	Result
Male	3.20	0.66	0.38	0.71	Do not Reject Ho	Not Significant
Female	3.16	0.74				

Table 6.1 displays the difference in the level of learning factors of the participants when grouped according to sex. At 0.05 level of significance, the result shows that there is no significant difference in the level of learning factors (p-value=0.71, t=0.38) between male (mean=3.20, SD=0.66) and female (mean=3.16, SD=0.74). This implies that male and female students have experienced the same level of learning factors such as accessibility, personal space, and learning autonomy in a blended learning modality.

However, the findings of the study by Liu et al. (2021) indicated that females performed better than males in the blended learning modality.

Table 6.2 *Difference in the Level of Learning Factors of the Participants when Grouped According to Strand*

Strand	Mean	Standard Deviation	F-value	p-value	Decision	Result
ABM	3.37	0.53	1.27	0.28	Do not Reject Ho	Not significant
HUMSS	3.17	0.77				
STEM	3.14	0.70				

Table 6.2 indicates the difference in the level of learning factors of the participants when grouped according to strand. At 0.05 level of significance, the result shows that there is no significant difference among the strands (p-value=0.28, F-value=1.27). This

implies that the level of learning factors of the participants in the academic strands of ABM (mean=3.37, SD=0.53), HUMSS (mean=3.17, SD=0.77), and STEM (mean=3.14, SD=0.70) experienced similar levels of learning factors in a blended learning modality.

Additionally, the result was confirmed by the key informants from different strands. According to the key informants from ABM Strand: key informant 1, "I find it difficult understanding lessons under the blended learning. I am more motivated and inspired by face-to-face learning than by blended learning. I experienced so many challenges in a blended learning class. The challenges that I have experienced in blended learning classes were distractions by ambient noises resulting in loss of focus, a slow internet connection, and there were lessons that I do not understand," says key informant 3. Moreover, the key informants from HUMSS Strand stated: key informant 4, "It was a difficult experience learning in a blended learning modality because no teacher is guiding me and providing corrections. Key informant 5 added, "I experienced difficulties while attending my online class because the connection is not good. In modular, sometimes there were topics that I cannot understand." Furthermore, the key informants from the STEM Strand said: key informant 2, "I have encountered many challenges during blended learning, one of those things is having a hard time learning. The work was so overwhelming that I could not learn that much." For key informant 6, "There were difficulties that I experienced in a blended learning class like unstable internet connection, not having a quiet place to study, and I cannot catch up on the lesson because the explanation is very fast in the video and there were a lot of distractions like Facebook, Tiktok, Instagram, etc." Conversely, the study of Bouilheres, et al. (2020) revealed that students vary in their responses towards their experiences with a blended learning approach.

Table 6.3 *Difference in the Level of Learning Factors of the Participants when Grouped According to School of Origin*

School of Origin	Mean	Standard Deviation	t-value	p-value	Decision	Result
Public	3.25	0.72	0.90	0.37	Do not Reject Ho	Not significant
Private	3.15	0.69				

Table 6.3 shows the difference in the level of learning factors of the participants when grouped according to strand. At 0.05 level of significance, the result shows that there is no significant difference in the level of learning factors (p-value=0.37, t=0.90) between public (mean=3.25, SD=0.72) and private (mean=3.15, SD=0.69). This implies that students have similar level of learning factors experienced during the blended learning modality considering their school of origin. In connection, the study of Johnson (2020) revealed that students in the public school system often perform multiple grade levels below their typically-developing peers in Mathematics achievement.

Table 7.1 *Difference in the Level of Academic Performance of the Participants when Grouped According to Sex*

Sex	Mean	Standard Deviation	t-value	p-value	Decision	Result
Male	90.05	3.74	-3.31	0.00	Reject Ho	Significant
Female	91.80	4.05				

Table 7.1 displays the difference in the level of academic performance of the participants when grouped according to sex. At 0.05 level of significance, the result shows that there is a significant difference in the level of academic performance (p-value=0.00, t=-3.31) between male (mean=90.05, SD=3.74) and female (mean=91.80, SD=4.05) implying that female students performed better than male students in Mathematics. In addition, PISA (2018) found out that female students performed significantly better than male students in the Philippines.

In line with this, the study of Jiang (2021) revealed that female students' academic performance in high school Mathematics was significantly better than male students in some content areas of Mathematics. On the other hand, the study also found out that in some content areas of Mathematics, there is no significant difference in the academic performance of male and female students.

Table 7.2 *Difference in the Level of Academic Performance of the Participants when Grouped According to Strand*

Strand	Mean	Standard Deviation	F-value	p-value	Decision	Result
ABM	89.50	3.29				
HUMSS	88.88	3.65	22.66	0.00	Reject Ho	Significant
STEM	92.39	3.70				

Table 7.2 shows the difference in the level of academic performance of the participants when grouped according to strand. At 0.05 level of significance, the result shows that there is at least one pair among the strands having a significant difference (p-value=0.00, F-value=22.26). This implies that the level of academic performance of the participants in the academic strands of ABM (mean=89.50, SD=3.29), HUMSS (mean=88.88, SD=3.65), and STEM (mean=92.39, SD=3.70) differ in a blended learning modality.

In addition, on multiple comparisons using Scheffé Test, at 0.05 level of significance, STEM and ABM (p-value=0.001), STEM and HUMSS (p-value=0.000) showed a significant difference. The STEM curriculum differs from the other strands and tracks in that it focuses on more advanced concepts and topics (edukasyon.ph, 2021), which led to students performing better in Mathematics than in other strands, as shown by the table, which also shows that STEM students have the highest mean score of 92.39. The table, however, shows that the mean scores of students in ABM and HUMSS were closely matched in value, suggesting that the students from the two strands indicated have comparable levels of academic competence in Mathematics.

Table 7.3 *Difference in the Level of Academic Performance of the Participants when Grouped According to School of Origin*

School of Origin	Mean	Standard Deviation	t-value	p-value	Decision	Result
Public	90.45	4.11	-1.18	0.24	Do not Reject Ho	Not significant
Private	91.15	3.93				

Table 7.3 presents the difference in the level of academic performance of the participants in terms of school of origin. At 0.05 level of significance, the result shows that there is no significant difference in the level of academic performance (p-value=0.24, t=-1.18) between public (mean=90.45, SD=4.11) and private (mean=91.15, SD=3.93) implying that the school of origin has no impact on the academic performance of the students.

However, the study of McDonough, Roychowdhury, and Dhamija (2021) affirmed that private school students outperform their public-school counterparts. Additionally, the results of PISA (2018) confirmed this, stating that the mean score for mathematical literacy of students in private schools was significantly higher than the mean score of students in public schools. Hence, a typical student from a private school can answer straightforward math problems, while an average student from a public school may have difficulty doing the same tasks.

Table 8.1 *Relationship between Mathematics Self-Concept and Academic Performance*

Variables	r-value	p-value	Decision	Result
Mathematics Self-Concept in terms of Learning and Academic Performance	−0.04	0.55	Do not reject H_o	Not Significant
Mathematics Self-Concept in terms of Organization and Academic Performance	−0.03	0.66	Do not reject H_o	Not Significant
Mathematics Self-Concept in terms of Dynamics and Academic Performance	−0.06	0.37	Do not reject H_o	Not Significant
Mathematics Self-Concept as a whole and Academic Performance	−0.05	0.49	Do not reject H_o	Not Significant

Table 8.1 displays the relationship between Mathematics self-concept and academic performance. At 0.05 level of significance, the result shows that there is no significant relationship on mathematics self-concept in terms of learning (p-value=0.55, r=-0.04), in terms of organization (p-value=0.66, r=-0.03), in terms of dynamics (p-value=0.37, r=-0.06), and mathematics self-concept as a whole (p-value=0.49, r=-0.05) to academic performance. Additionally, the table reveals a very weak negative correlation, implying that Mathematics self-concept as a whole and in each of the following areas: learning, organization, dynamics has less impact on the academic performance of the participants.

In terms of learning, the result of the interview from the key informants disagreed, key informant 2 said, "I have encountered many challenges during blended learning." One of those things is having a hard time learning."; key informant 4 added, "It was difficult learning in blended learning because no one was able to facilitate my learning."; and key informant 5, "In blended learning, sometimes there were topics that I cannot understand." In support, the study of Silva et al. (2018) revealed that learning Mathematics affects the

performance among grade 12 students in Negros Oriental State University and explains that Mathematics is very useful in life. However, the study also found out that Mathematics is impossible or cannot be easily learned.

In terms of organization, key informant 3 mentioned that "I avoided things that could distract me first, started my learning by reading the learning resources assigned to me by my teacher. I also watched Google tutorials for further knowledge, and constantly asking my classmates and teacher about the topics assigned." Conversely, key informant 1 said that "I experienced so many challenges in a blended learning class." I became too lazy in doing my school works and I procrastinated a lot." The study of Moliner, Alegre, and Valentin (2022) affirmed that students enrolled in the previous year before the pandemic outscored their peers during the pandemic. This study shows that the COVID-19 pandemic significantly and negatively affected students' academic achievement. It further shows changes in educational settings, students' lack of motivation, monotony, and students' level of responsibility as factors that explain this phenomenon.

In terms of dynamics, key informant 1 said, "I am the type of learner who see mathematics as a very difficult subject even if I watched tutorial videos." key informant 2 agreed, stating, "I find mathematics as a challenging subject to deal with." Moreover, key informant 4 added, "It was quite difficult for me to understand the lessons because I am not good in mathematics but still, I am trying my best to solve the problems at my own pace." Additionally, the study of Almarashdi and Jarrah (2021) found that the students had an ambivalent view of their distance learning experience. Furthermore, the impact of blended learning or flexible learning on the academic performance of the learners is also challenged.

The study of Pietsch et al. (2003), as cited by Pasco (2021), agreed with this result, hence finding that self-concept was not highly related to performance in Mathematics. However, the findings of Rubie-Davies and Meissel (2019) revealed that Mathematics self-concept has been positively associated with Mathematics achievement and student ratings of their skill, enjoyment of, and interest in Mathematics.

Table 8.2 *Relationship between Learning Factors and Academic Performance*

Variables	r-value	p-value	Decision	Result
Learning Factors in terms of Accessibility and Academic Performance	0.04	0.56	Do not reject H_o	Not Significant
Learning Factors in terms of Personal Space and Academic Performance	0.00	0.95	Do not reject H_o	Not Significant
Learning Factors in terms of Learning Autonomy and Academic Performance	0.03	0.64	Do not reject H_o	Not Significant
Learning Factors as a whole and Academic Performance	0.03	0.70	Do not reject H_o	Not Significant

Table 8.2 displays the relationship between learning factors and academic performance. At 0.05 level of significance, the result shows that there is no significant relationship on learning factors in terms accessibility (p-value=0.56, r=0.04), in terms of personal space (p-value=0.95, r=0.00), in terms of learning autonomy (p-value=0.64, r=0.03), and learning factors as a whole (p-value=0.70, r=0.03) to academic performance. Additionally, the table reveals a very weak positive correlation, implying that learning factors as a whole and in each of the following areas: accessibility, personal space, learning autonomy has less impact on the academic performance of the participants.

In terms of accessibility, the result of the interview from the key informants disagreed, according to key informant 5, "I experienced difficulties while attending my online class and the internet connection is poor." key informant 6 added, "One difficulty that I experienced in a blended learning class is unstable internet connection...". According to Lynch (2017), the lack of internet access affects a student's academic performance. Students who do not have access to the internet are unable to communicate with teachers or classmates, conduct independent research, or seek online homework assistance.

In terms of personal space, key informant 6 said, "I experienced certain difficulties in a blended learning class like not having a quiet place to study, and I could not catch up on the lesson because the explanation was very fast in the video and there were a lot of distractions like Facebook, Tiktok, Instagram, etc." This shows that the learning factors in personal space affect the students' academic achievement. Moreover, according to Hendrix (2019), there are several factors that can affect learning ability, including seating, light, noise, and even color. Students who study in a positive learning environment have been shown to be more motivated, engaged, and have a higher overall learning ability.

In terms of learning autonomy, according to key informant 1, "Even if I watched tutorial videos, I still find it too hard understanding the lessons." key informant 2 agreed, stating that "I have encountered many challenges during blended learning. One of those things is having a hard time learning." Moreover, key informant 4 confirmed that, "It was very difficult studying in a blended environment because no one assisted me in my learning." This means that students' learning autonomy is highly related to their academic performance. Furthermore, developing autonomy is a skill that enables the learner to assess both their conduct and language acquisition strategies. Learning more effectively and applying what they have learned to wider situations may be made possible by the learners' capacity to make decisions and act independently (Ahmed, 2020).

In addition, other key informants added, "I started by reading my lessons and watching Google tutorials for further knowledge. I also asked my classmates and teacher about the lessons assigned to us," said key informant 3. "In blended learning class, it became easy. I learned to cheat." key informant 5 agreed, saying, "During the blended learning, I learned how to seek help from an expert when I cannot understand the topic." It implies that although there was a very weak correlation, the qualitative part revealed that there were aids on the internet that gave easy access to students upon answering. Mamolo (2022), found out that there are learning factors that affect how the learners receive, stimulate, behave, and react in their learning process, which effects their academic performance.

Conclusion

The students excel in Mathematics before the COVID-19 pandemic. However, due to lot of distractions and being at home, the students were merely following the guidelines and instructions of the teachers in complying the activities and assignments thoroughly and on time. Moreover, it was discovered that the students have problems in understanding the concepts and lessons in Mathematics.

During the blended learning modality, connectivity and personal space were crucial considerations when studying at home due to different disruptions and noises. On the other hand, it showed that when they answer problem sets, they make it as an opportunity to work well with others and used variety of online resources as learning materials.

As a result of students' reliance on the internet, mobile applications, parents, experts, tutors, and friends in answering their activities, it might be challenging for students to comprehend and understand the Mathematical concepts and problems on their own. Furthermore, academic achievement in mathematics is inversely correlated with mathematics self-concept and has a weak correlation on learning factors. Even though there is a weak correlation between academic performance in general Mathematics, mathematics self-concept and learning factors in blended learning, this still shows that the students were honest about their level of mathematics self-concept and recognized learning factors that were barriers to their studies.

Additionally, the qualitative testimonies showed the importance of internet, parents, professionals, and friends in the academic success of the students. As a result, utilizing the tool to design exercises made the students get high marks in general mathematics quicker, easier, and more convenient.

In view of the aforementioned findings and conclusions there were recommendations made. First, the administrators should create an intervention to improve the students' interest and willingness in mathematics, as well as their self-concept and long-term goals in integrated learning. In addition, when classes resume in a face-to-face setting, a test assessment should be conducted to assess students' learning.

Second, math coordinators should engage students in a positive, supportive, and collaborative mathematics environment. In addition, there must be a monitoring and evaluation of students' connectedness and learning modality. Thus, in a face-to-face limited instruction there should have a diagnostic test. They might also create a curriculum that promotes a strong sense of self-worth while providing a secure setting for mathematics. Additionally, since so many students in the twenty-first century rely on technology, there should be in a curriculum that employs it, as they would proclaim, "Math is For Me."

Third, mathematics teachers should examine how and where interventions can improve students' mathematics beliefs and attitudes over time, as well as the feasibility of learners relying on local connectivity. To gauge the students' level of academic performance without the assistance of the internet, administer an on-the-spot pre-test. Additionally, teachers should employ technology and the internet since students rely on it, making them more productive and efficient.

Fourth, parents should ensure that students have a comfortable space where they may focus on their

academic work without disruptions or noise. Follow up on assignments must also be monitored by parents to ensure that students are doing the tasks given to them by their teachers.

Fifth, students' involvement must be strengthened and develop a strong self-concept in mathematics, as well as open up to the state of location on connectivity status and analyze capabilities by taking the test without using the internet.

Lastly, future researchers should further study the mathematics self-concept and learning factor during face-to-face classes that affect the academic performance of the students.

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