Student satisfaction in online general education mathematics courses

Estrada, Lloyd T. ✉
Holy Angel University, Philippines (lloydtestrada1981@gmail.com; ltestrada@hau.edu.ph)

Abstract

One important factor that plays a crucial role in gauging the quality of programs in higher education offering online courses is student satisfaction (Alqurashi, 2019; Kuo et al., 2014; Parahoo et al., 2015). The study investigated the college students' perceived satisfaction with online learning in General Education mathematics courses in terms of types of interaction and general satisfaction. The study sample comprised 304 students enrolled in General Education mathematics courses from one university. Results show that 65.1% were at least satisfied with learning the courses in an online learning environment. The learner-content interaction and learner-interface garnered the highest and lowest satisfaction ratings, respectively. Students enrolled in General Education additional mathematics courses reported dissatisfaction with online learning. There was no significant difference in satisfaction ratings with online learning in terms of year level (t(242)=0.95, $p<.35$). However, students enrolled in General Education mathematics courses significantly obtained higher satisfaction rating than those enrolled in additional courses (t(59)=-9.87, $p<.001$). The findings provided clear support for how the students interact with the course content, their teachers, their peers, and the learning management system provided satisfying online experience. Results of this study provided baseline data on student satisfaction with online learning and for planning and policy evaluation of a model of online delivery of education. Lastly, findings of the study could be beneficial for General Education mathematics teachers in designing online learning activities that could increase student satisfaction with online learning in mathematics courses.

Keywords: student satisfaction, online learning, interactions, general education mathematics courses, higher education

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1. Introduction

The rise of online learning is a sudden shift in the worldwide education market (Li & Lalani, 2020). The delivery of education, especially in higher education, has changed drastically whereby teaching is conducted distantly and on online environment to achieve access and continuity to education in times of pandemic. Along this line of development, assessment of the quality of instruction and learning outcomes in various courses in an online environment is deemed necessary for program evaluation. One important factor that plays a crucial role in gauging the quality of programs in higher education offering online courses is student satisfaction (Alqurashi, 2019; Blundell et al., 2020, Zhou, 2024). It must be the utmost goal of higher education institutions to satisfy their students on their learning experiences (Jala et al., 2016).

Even before COVID-19 pandemic, online learning has gained popularity, especially in higher education. Issued in the Paris Message, higher educational institutions are encouraged to adopt "online, open, and flexible system practice" as a global response in reinforcing educational systems, effective and quality learning, access to information, and dissemination of knowledge (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015). It is essential for higher education institutions to strengthen their curricular policies and practices which respond to the students' needs even beyond the traditional delivery mode of education (Tuquero, 2020). Several local universities have offered online learning or distance education to cater students who wish to complete their degrees or graduate programs through a convenient and practical non-traditional learning (Katigbak, 2018) before the COVID-19 outbreak. For instance, AMA University Online Education is the first full online education in the country, and the University of the Philippines Open University and New Era University established distance education to select programs where students undergo independent study through synchronous and asynchronous online learning (Katigbak, 2018).

With the advent of internet and technology, online learning has become evident as the new paradigm in contemporary education. In Doo et al. (2019), online learning, also known as e-learning, is a form of distance education that takes place with the help of a web-based learning management system and different types of technological gadgets. Online learning may be done synchronously or asynchronously through different online media. Synchronous online learning happens in real time where the instructor and students interact in a specific virtual environment (like video conferencing, live chat rooms, and live-streaming lectures) at a designated time (The Best Schools, 2018). On the other hand, asynchronous online learning occurs without real time interaction. The students have access to the course materials and requirements provided by the teacher and complete these within a flexible time frame (The Best Schools, 2018).

Online learning in higher education may be challenging for various regions. In Li and Lalani (2020), without reliable internet access or technological tools may cause students to struggle to participate in digital learning. For instance, according to the Department of Information and Communications Technology (DITC) in its National Broadband Plan, only 40 percent of Filipinos and 28 percent of households have internet access; and the average broadband speed was 4.2 Mbps (DICT, 2017). The CHED has mandated to continue delivery of education through online, open, and flexible system practice of delivering quality education. It is with high hope that university, with its zealous endeavor in developing a model for online education, will remain true to the 'No Student Left Behind' advocacy. Consequently, if students are satisfied with their online learning experiences provided by the university, they will manifest loyalty towards the university.

The delivery of instruction during the implementation of the first phase of community quarantine in the country has become the biggest challenge for several private and state universities and colleges. As a response to this challenge, higher education institutions have taken different flexible approaches such as online learning and

distance education to complete their respective academic calendar (Hernando-Malipot & San Juan, 2020; Tuqero, 2020). However, several student organizations petitioned for termination of current academic semester and suspension of online classes amid the COVID-19 outbreak (CNN Philippines, 2020). Unreliable internet access and lack of learning devices are among the cited reasons for the petition (San Juan, 2020). Remote or distance learning has made it more challenging for mathematics and science students to cope with their studies (Franco et al., 2023). In anticipation of the anxiety of students would be experiencing and the socio-cultural impact of the pandemic, the satisfaction level of students with online learning may be at stake. Thus, this concern is worth considering for further study.

Student satisfaction is "a short-term attitude resulting from an evaluation of students' educational experience, services and facilities" (Weerasinghe et al., 2017 p. 533). In this study, student satisfaction is referred to the relative level of experience and perceived performance of students in higher education courses through online delivery of instruction for a period of one semester. Satisfaction underscores the importance of enhancing online learning outcomes and the overall quality of education (Zhou, 2024). Over the years, several researchers have explored and found significant relationship between student satisfaction with online learning in higher education and a wide range of factors (Blundell et al., 2020; Ke & Kwak, 2013: Kucuk & Richardson, 2019; Weerasinghe et al., 2017;). These determining factors that influence student satisfaction include teaching presence, cognitive presence, emotional engagement, behavioral engagement, cognitive development (Kucuk & Richardson, 2019), student-student interactions, physical facilities, faculty empathy, marketing construct of university reputation (Blundell et al., 2020), learner-instructor interaction, learner-content interaction, learner evidence, learner relevance, active learning, learner autonomy, authentic learning, computer technology competence (Ke & Kwak, 2013), learner computer anxiety, instructor attitude toward online learning, online learning course flexibility, online learning course quality, perceived usefulness, perceived ease of use, and diversity in assessments (Doo et at., 2019). Hence, student satisfaction with online learning is a multidimensional construct (Weerasinghe et al., 2017) which is worthy of further research for the improvement in instructional delivery.

In the light of the empirical evidence and ideas presented and with the rising concerns on effectiveness of online learning amid the pandemic, the present researcher was motivated to conduct an exploratory study on this topic to better understand how college students perceive satisfaction with online learning in General Education mathematics courses. The emphasis on mathematics courses in the context of online learning is increasingly relevant due to the unique challenges these subjects present in a digital environment. Mathematics relies heavily on interactive engagement, problem-solving, and immediate feedback, all of which can be difficult to replicate in asynchronous online formats. The transition to online learning necessitated by global events has illuminated disparities in student engagement and understanding, particularly in complex subjects like mathematics, where conceptual grasp is paramount. This study is timely as it seeks to address the evolving pedagogical strategies that can enhance mathematical instruction online, exploring how innovative technological tools and collaborative platforms may bridge gaps in learning outcomes. Furthermore, understanding the implications of this shift is essential for educators to adapt their teaching methodologies to foster effective learning experiences in an increasingly digital academic landscape. In Nortvig et al. (2018), there is a strong interest within the field of educational research to determine which factors affect student satisfaction with online learning in higher education. Although several studies have explored the varied factors that influence student satisfaction with online learning, investigation on the reasons why the students are satisfied or dissatisfied is limited (Davis, 2017). In view of this, the present researcher sought to investigate the common online experiences that may influence the satisfaction and dissatisfaction of students with online learning in General Education mathematics courses.

This study provides baseline data on student satisfaction with online learning and for planning and policy evaluation of a model of online delivery of education. Similarly, the study may assist higher education institutions in identifying approaches to increase student satisfaction with online education and students and parents in making tertiary-education-related choices. The study sought to help mathematics teachers in developing their courses in the learning management system and to provide them information on which area of teaching process needs improvement so that student satisfaction with online learning will be cultivated. More importantly, this study may

provide a significant contribution in literature regarding the use of online learning and student satisfaction in mathematics courses, especially in higher education.

Research Objectives - The aimed at achieving these objectives:

➢ Determine the students' level of satisfaction with online learning in General Education mathematics courses.

➢ Assess the students' overall level of satisfaction with online learning in General Education mathematics courses.

➢ Examine the significant differences in the students' overall level of satisfaction with online learning in General Education mathematics courses when grouped according to their year level taking the General Education core mathematics course, and enrolled General Education mathematics courses.

2. Literature Review

Factors Influencing Student Satisfaction with Online Learning - Over the years, several studies have investigated and found a significant relationship between student satisfaction with online learning in higher education and a wide range of factors. These determining factors that influence student satisfaction include teaching presence, cognitive presence, emotional engagement, behavioral engagement, cognitive development (Kucuk & Richardson, 2019), student-student interactions, physical facilities, faculty empathy, marketing construct of university reputation (Blundell et al., 2020), learner-instructor interaction, learner-content interaction, learner evidence, learner relevance, active learning, learner autonomy, authentic learning, computer technology competence (Ke & Kwak, 2013), learner computer anxiety, instructor attitude toward online learning, online learning course flexibility, online learning course quality, perceived usefulness, perceived ease of use, and diversity in assessments (Doo et al., 2019).

In Kucuk and Richardson (2019), among the abovementioned factors, teaching presence was found to be the dominant determinant of student satisfaction. Additionally, data in Blundell et al. (2020), student-student interactions, physical facilities, faculty empathy, and marketing construct of university reputation are critical contributors to student satisfaction with online learning in increasing significance. Five elements of student-centered learning are significantly related to student satisfaction with online courses (Ke & Kwak, 2013). These elements include learner evidence, learner relevance, active learning, learner autonomy, authentic learning, and computer technology competence. In terms of interaction construct, learner-instructor interaction and learner-content interaction coupled with technology efficacy are significant predictors of student satisfaction. Learner-learner interaction may be negligible in online setting courses. Among the factors influencing student satisfaction with online learning which is emphasized is interaction (Alqurashi, 2019; 2014; Blundell et al., 2020, Doo et al., 2019). Interaction is defined as "the interaction a learner has with the course content, class instructor, and their peers" (Alqurashi, 2019, p. 134). It is considered a vital element in teaching-learning process (Anderson, 2003).

Types of Interaction in Online Learning - The Framework for Interaction Types and Interactive Functions in Online Learning proposed by Chien Chou (2003), which is patterned from the Interaction Equivalency Theorem proposed by Terry Anderson (2003), presents three common types of interactions, namely student-student interaction, student-teacher interaction, and student-content interaction. Interaction in online learning occurs when there the students engage with the course content, the teacher, other students, and the technological medium used in a course (Chou, 2003). It is the central point of the teaching-learning process. However, considering the notable advent of technology in the delivery of instruction, Hillman, Willis, and Gunawardena (1994) (as cited in Chou, 2003) included a fourth type of interaction to the distance education or online education. This interaction is called learner-interface or learner-technology interaction that occurs between a learner and a technological medium. The descriptions of these types of interaction are adopted from the work of Chou (2003).

Learner-Content Interaction. In an online learning environment, students are mostly supposed to learn on their own. Learner-content interaction is an interaction between a student and the content to be learned. Moore (1989, as cited in Chou, 2003) defines learner-content interaction as "the process of intellectually interacting with content that results in changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (p. 268). In this type of interaction, students can navigate to other sites that contain related information, access learning resource materials, access online quizzes or activities, and receive information directly to their online accounts.

Learner-Teacher Interaction. In learner-teacher interaction, the teacher facilitates the delivery of instruction by stimulating or maintaining students' interest in what to be taught and to be learned. The teacher provides directions to students. This type of interaction is associated with the traditional classroom teaching or face-to-face teaching where students could interact with their teachers through synchronous and/or asynchronous classes. In learner-teacher interaction, students can attend synchronous classes, write an email to their teacher, and consult their teachers.

Learner-Learner Interaction. Learners do not interact only with the content and the teachers, but also with the other students. Learner-learner interaction provides opportunities for students to interact with their classmates. In this respect, Moore (1989, as cited in Chou, 2003) portrays this type of interaction as an interactive process between one learner and other learners, alone or in group settings, with or without the real-time presence of a teacher. In learner-learner interaction, students can communicate with their classmates through email or group chats synchronously.

Learner-Interface Interaction. Lastly, the learner-interface interaction occurs in distance learning when students manipulate various technological tools to achieve a task which eventually enables the students to gain knowledge and skills (Chou, 2003). In this type of interaction, students can learn a course through a learning management system, download and use files of software from a system for learning, and track their performance records.

Student Satisfaction with Online Learning - Grounded in transformational learning theories, the study of Tanguihan (2024) examined higher education students' satisfaction with online learning during the COVID-19 pandemic. Results showed that students had neutral satisfaction levels, valuing instructor support, guidance, and personalization, but expressing low satisfaction with the knowledge and skills acquired. They appreciated webinars and extracurricular activities yet sought better facilities and physical resources. Most preferred blended or face-to-face instruction over fully online classes, highlighting the importance of diverse learning modalities and effective digital tools. Overall satisfaction was positively linked to students' willingness to recommend online learning in the future.

In 2015, a survey on students' satisfaction with online student portal in a distance online learning environment showed that 85 percent of undergraduate students were satisfied or very satisfied with their overall experience with the online portal (Secreto & Pamulaklakin, 2015). Recently, the University Student Council of Holy Angel University conducted a survey of the satisfaction of students with online learning during summer classes and the survey showed that teachers were prepared to handle online classes and students reported overall satisfaction with online instruction (K. Tolentino, personal communication, June 18, 2020). As far as student satisfaction with their learning experience in different delivery modes of instruction is concerned, studies have shown that there was no significant difference in student satisfaction in traditional, online, and blended learning of continuing education courses (Goerke, 2018). Moreover, empirical evidence shows that student satisfaction with online learning is also positively associated with motivation (Feudo and Cuizon (2022). This indicates that the respondents' satisfaction level is largely influenced by their motivation to engage in online learning.

General Education Mathematics Courses - Another important concept of this research focuses on the General Education mathematics courses. The indispensable role of mathematics in national development has long been recognized and prompts countries to forward innovative curricular reforms and policies. One major curricular

reform in mathematics education in the country, particularly in higher education, is the inclusion of Mathematics in the Modern World as one of the core courses in the New General Education Curriculum because of changes and adjustments introduced in the basic education curriculum (Remo, 2019). As per CHED Memorandum Order No. 20, series of 2013, Mathematics in the Modern World is one of the eight new General Education core courses that deals with "nature of mathematics, appreciation of its practical, intellectual, and aesthetic dimensions, and applications of mathematical tools in daily life" (CHED, 2013). This means that all college students need to enroll in this course. At the university level, Mathematics in the Modern World is not simultaneously taken up by all college students. Some schools of the university offer this course during the first semester, other schools during the second semester.

Aside from Mathematics in the Modern World, the university is also offering other general education mathematics courses to its students such as Linear Algebra, Probability and Statistics, Analytic Geometry, Calculus, and Integral Calculus. These are additional courses required for General Education mathematics courses. Probably, many mathematics teachers would agree that the last two mentioned mathematics courses are difficult to teach and learn even in a traditional learning environment. Learning-content interaction, which is a crucial factor in determining student satisfaction with online learning, may be problematic for a mathematics course because of course content difficulty. In the study of Remo (2019), first year college students from a state university found mandatory and optional topics in Mathematics in the Modern World difficult. Based on observation, some college students tend to exhibit negative attitude toward mathematics in a traditional learning environment.

3. Materials and Methods

Research Design - This study employed a descriptive-survey research design since the intention of this study was to describe the college students' satisfaction with online learning in General Education mathematics courses. This research design allowed the researcher to gather and describe information on the students' demographic data and satisfaction with online learning upon the completion of general education mathematics course through a survey.

Sample and Setting - The respondents of the study were 304 college students who enrolled at Holy Angel University and who completed General Education mathematics courses during the semester through an online learning environment. Consecutive sampling was employed because the study sought to include all accessible respondents who are qualified as part of the sample. In this sampling procedure, the researcher ensured that there is sufficient period to achieve desired sample size of respondents.

Research Instrument - Since student satisfaction with online learning is of concern to higher education institutions, having valid and reliable instruments to measure student satisfaction is necessary. The research instrument used was developed by Strachota (2006) – the Student Satisfaction Survey. This instrument could be utilized by schools or universities to assess student satisfaction with online learning as a program evaluation outcome. The survey instrument covers the types of interaction – learner-learner, learner-instructor, learner-content, and learner-interface interactions and general satisfaction. The psychometric properties of the Student Satisfaction Survey indicated that the questions within each construct have strong internal and construct validity, making the instrument highly reliable for measuring affective outcomes. The factor loading for learner-content interaction ranged from .604 to .780, learner-instructor interaction factor loading ranged from .594 to .841 and learner-learner interaction factor loading ranged from .588 to .786. While the reliability coefficient of the instrument using Cronbach's alpha is .97 for learner-technology interface interaction, .90 for learner-content interaction and general satisfaction, and .89 for learner-learner interaction and learner-instructor interaction.

The instrument has two parts. The first part of the instrument covered individual respondents' data such as enlisted academic program, year level, and enrolled General Education mathematics courses. The second part considered items that measure the students' general satisfaction with online learning and student satisfaction with online learning based on types of interactions. The survey items included a four-point Likert scale of strongly

disagree, disagree, agree, and strongly agree. Likert scale entails the assigning of points for each response on a positive statement or negative statement. For positively stated items, the scale (corresponding points) is as follows: strongly agree (4), agree (3), disagree (2), and strongly disagree (1). For negatively stated items: strongly agree (1), agree (2), disagree (3), and strongly disagree (4). Questions specific to each construct within the Student Satisfaction Survey. The revised instrument was subjected to pilot test before administering to the respondents who will not take part in the actual study. The Cronbach's alphas for the subscales of the instruments, namely learner-content interaction, learner-teacher interaction, learner-learner interaction, learner-interface interaction, and general satisfaction were .869, .713, .878, .864, and .794, respectively.

Data Collection - For this study, an online survey developed from Google Form was conducted to gather and collect data via Google Form. The invitation and link of this survey form, together with informed consent, was sent to students who have taken general education mathematics courses. The invitation was forwarded via Canvas Announcement pane during the last week of the intended semester. The students of the researcher did not participate as respondents of the study to avoid the threat of undue influence.

Data Analysis - To facilitate data analysis of quantitative information of the survey, descriptive statistics such as frequencies, percentages, mean, and standard deviation were processed to describe the demographic profile of respondents and level of satisfaction with online learning. The level of student satisfaction with online learning in general education mathematics courses were determined by mean score of the responses. The following score range will be used for verbal interpretation: 3.51 – 4.00 (very satisfied), 2.51 – 3.50 (satisfied), 1.51 – 2.50 (dissatisfied), and 1.00 – 1.50 (very dissatisfied). To determine the significant differences, F-test for equal variances, independent t-tests, and Welch's t-test were employed at 5% level of significance.

Ethical Consideration - In conducting this study, the following ethical considerations were ensured for the participants and sought the approval of the university's Institutional Review Board. Informed consent from the respondents were obtained. The respondents were oriented or informed about the study to understand what they are taking part in the study and know what is required of them. They were informed about the purpose of the study and the methods being used. Participation in the study was voluntary and may withdraw anytime without undue consequence. Privacy and confidentiality of data was safeguarded. The anonymity of respondents, any information obtained from them was protected at all stages of the research process from collection to reporting. The data was kept in a password-protected file and device for five years and will then be destroyed. The use of secondary source data was acknowledged with appropriate citation. Permission on the use of research instrument that measures student satisfaction with online learning was sought. With online-based data collection, consideration was given to the electronic security of the information and safety of the respondents and the researcher. The study guaranteed that it is not harmful to the respondents.

4. Results

The general aim of the study was to investigate college students' perceived satisfaction with online learning in General Education mathematics courses. The results and analyses of the data were derived and processed from 304 respondents who were enrolled in online General Education mathematics courses.

Profile of the Respondents - As shown in Table 1, 64.1% (195/304) of the respondents come from first year level followed by those in the second year and third-year levels at 24.7% (75/304) and 11.2% (34/304), respectively. There were no students enrolled in third year level to fifth year level in General Education core mathematics course. Likewise, there are no students enrolled in first year, fourth year, and fifth year levels in General Education additional mathematics courses. Regarding the distribution of the respondents according to their enrolled General Education mathematics courses, 80.3% (244/304) of the respondents are enrolled in Mathematics in the Modern World, which is the General Education core mathematics course. About 80% of the respondents enrolled in the General Education core mathematics course come from the first-year level. Moreover, out of 60 respondents enrolled in General Education additional mathematics courses, 50% of the respondents are enrolled in calculus-

related courses.

Table 1

Distribution of Respondents Based on Year Level and General Education Mathematics Courses

General Education Mathematics Courses	Year Level				
	1st Year	2nd Year	3rd Year		
	Frequency			Total	Percent
Core Course					
2MATHMWORLD	195	49	0	244	80.3
Additional Courses					
2LINALGEB	0	9	1	10	3.3
2PROBSTAT	0	10	10	20	6.6
2CALCULUS	0	7	1	8	2.6
2INTCAL	0	0	22	22	7.2
Total	195	75	34	304	100
(Percent)	(64.1)	(24.7)	(11.2)	(100)	

Note. 2MATHMWORLD – Mathematics in the Modern World, 2LINALGEB – Linear Algebra, 2PROBSTA – Probability and Statistics, 2CALCULUS – Basic Calculus, 2INTCAL – Integral Calculus

Student Satisfaction with Online Learning in Terms of Interactions and General Satisfaction - The students' satisfaction with online learning in General Education mathematics courses can be described in terms of 5 subscales using the Student Satisfaction Survey instrument: learner-content interaction, learner-teacher interaction, learner-learner interaction, learner-learner interaction, learner-interface interaction, and general satisfaction. The following score range was used for verbal interpretation of student satisfaction level: 3.51 – 4.00 (very satisfied), 2.51 – 3.50 (satisfied), 1.51 – 2.50 (dissatisfied), and 1.00 – 1.50 (very dissatisfied). Table 2 summarizes the descriptive statistics on student satisfaction in General Education mathematics courses in terms of the types of interaction and general satisfaction. Among the subscales pertaining to types of interaction, the learner-content interaction garnered that highest mean satisfaction rating (M = 3.40, SD = 0.60) signifying that interacting with the mathematics course content through online is at satisfied level. The same satisfaction level holds true for the other three types of interaction (learner-learner, learner-teacher, and learner-interface) with the mean satisfaction ratings ranging from 3.25 to 3.34.

Table 2

Descriptive Statistics of Student Satisfaction with Online Learning in General Education Mathematics Courses

General Education Mathematics Courses						
	Core Course (N = 244)		Additional Courses (N = 60)		All Courses (N = 304)	
Subscales	M (SD)	Interpretation	M (SD)	Interpretation	M (SD)	Interpretation
Learner-Content Interaction	3.50 (0.51)	Satisfied	2.99 (0.74)	Satisfied	3.40 (0.60)	Satisfied
Learner-Teacher Interaction	3.45 (0.52)	Satisfied	2.91 (0.66)	Satisfied	3.34 (0.59)	Satisfied
Learner-Learner Interaction	3.41 (0.56)	Satisfied	3.03 (0.66)	Satisfied	3.34 (0.60)	Satisfied
Learner-Interface Interaction	3.31 (0.49)	Satisfied	3.01 (0.73)	Satisfied	3.25 (0.56)	Satisfied
General Satisfaction	2.93 (0.59)	Satisfied	2.39 (0.75)	Dissatisfied	2.82 (0.66)	Satisfied

Note. 2MATHMWORLD – Mathematics in the Modern World, 2LINALGEB – Linear Algebra, 2PROBSTA – Probability and Statistics, 2CALCULUS – Basic Calculus, 2INTCAL – Integral Calculus

Furthermore, the respondents who were enrolled in General Education core mathematics course reported highest mean satisfaction rating in terms of learner-content interaction (M = 3.50, SD = 0.51), while the respondents who were enrolled in General Education additional mathematics courses reported highest satisfaction rating in terms of learner-learner interaction (M= 3.03, SD = 0.66) indicating the respondents are at satisfied level in terms of their interaction with the course content and with their peers, respectively. On the other hand, learner-interface interaction obtained the lowest mean satisfaction rating (M = 3.31, SD = 0.49) for General Education

core mathematics course, while learner-teacher interaction obtained the lowest mean satisfaction rating (M = 2.91, SD = 0.66) for General Education additional mathematics courses. The mean satisfaction ratings are interpreted at satisfied level. As can be seen from Table 2, in terms of general satisfaction with online learning in General Education mathematics courses, the mean satisfaction rating is 2.82 (SD = 0.66), which indicates a satisfied level. Those respondents who were enrolled in the General Education core mathematics course reported satisfied level as supported by the mean satisfaction rating of 2.93 (SD= 0.59). On the other hand, it can be noted that those respondents who were enrolled in the General Education additional mathematics courses reported a dissatisfied level as supported by the mean satisfaction ratings of 2.39 (SD = 0.75).

Overall Student Satisfaction with Online Learning in General Education Mathematics Courses - The overall student satisfaction with online learning is the aggregate score of the five constructs in the Student Satisfaction Survey instrument. The overall satisfaction rating with online learning in General Education mathematics courses was determined by getting the weighted mean of corresponding ratings for all responses. Moreover, the level of satisfaction with online learning was interpreted for each respondent using the same score range and verbal interpretation. Based on descriptive analysis, the overall mean satisfaction rating for all General Education mathematics courses is 3.15 (SD = 0.48), indicating that the respondents obtained total satisfaction rating which is equivalent to satisfied level. The overall mean satisfaction rating for core mathematics course group (M = 3.23, SD = 0.42) is greater than the overall mean satisfaction rating for additional mathematics courses group (M = 2.81, SD = 0.57).

Of the 304 respondents, 81 or 26.6% were very satisfied and 198 or 65.1% were satisfied with learning the courses in an online learning environment. Moreover, out of 244 respondents who were enrolled in General Education core mathematics course, 74 (30.3%) are at very satisfied level and 158 (64.8%) are at satisfied level with online learning. For General Education additional mathematics courses, 11.7% (7/60) of the respondents are at a very satisfied level, while 66.7% (40/60) of them are at a satisfied level. On the other hand, 25 out of 304 (8.2%) respondents are dissatisfied or very dissatisfied with their online learning in General Education mathematics courses. Moreover, 20% (12/60) of the respondents enrolled in General Education additional mathematics courses and 4.9% (12/244) of the respondents enrolled in General Education mathematics core course reported dissatisfied level. It can be noted that no respondent enrolled in General Education core mathematics course expressed a very dissatisfied level.

Differences in Student Satisfaction with Online Learning - Students enrolled in the first year (M = 3.24, SD = 0.41) reported higher satisfaction ratings with online learning in the General Education core mathematics course than those in the second year (M = 3.18, SD = 0.41). However, this difference was not statistically significant, t(242) = 0.95, *p* = .35. The Welch's t-test indicated a significant difference in satisfaction ratings with online learning between groups, t(59) = -9.84, *p* < .001. Students enrolled in the General Education core mathematics course (M = 3.23, SD = 0.41) reported significantly higher overall satisfaction than those enrolled in the General Education additional mathematics courses (M = 2.81, SD = 0.57).

5. Discussions

The purpose of the study was to primarily gain a better understanding of student satisfaction with online learning in General Education mathematics courses during the current Covid-19 pandemic. This section presents the summary of the study's findings and their implications. The year level and nature of General Education mathematics courses were analyzed to provide valuable insights on student satisfaction when learning mathematics courses in an online learning environment based on the demographic profile. Majority of the students are college first-year students who were enrolled in the General Education core mathematics course (Mathematics in the Modern World) since it is a common mandatory course to all undergraduate students regardless of their programs (CHED, 2013). This mathematics course is programmed to be offered to first year and second year levels in the university. The General Education additional mathematics courses are offered to second year and third year students under specified programs only.

Vital to the investigation of student satisfaction with online learning are the four types of interactions in an online learning environment. Based on the results of the study, it appeared that the students were satisfied with their online learning in General Education mathematics courses in terms of learner-content, learner-teacher, learner-learner, and learner-interaction. This indicates that interaction of students with the course content, their teachers, their peers, and the learning management system provides satisfying experiences in learning mathematics course in an online learning environment. This finding provides evidence that the types of interactions influence the student satisfaction with online learning (Alqurashi, 2019; Blundell et al., 2020). Moreover, if students interact actively, they are more likely engaged in learning. When students are fully engaged in learning, they will manifest higher student satisfaction with online learning. This idea supports the claim that student engagement positively influences student satisfaction (Muzammil et al., 2020).

Among the types of interaction, learner-content interaction obtained the highest satisfaction rating indicating that the students were satisfied with how they interacted with the course content in General Education mathematics courses. This level of satisfaction can be explained by their awareness that the modular activities, learning resources, assignments, and projects facilitated their learning in mathematics courses. Likewise, activities requiring application of problem-solving skills helped their learning in an online environment. This implies that the course content for the General Education mathematics courses was carefully designed. This finding supports the results of the study of Kumar et al. (2021) which confirmed that the quality of online learning is influenced by online learning content. The quality of online learning between student satisfaction and learning content was found to be significant in this previous study.

In terms of learner-teacher interaction, noteworthy is the students' consensus on the role of the teacher in online class as an active member of the discussion group offering directions to posted comments or announcement. A substantial number of students expressed their agreement on recognition of teachers' function as facilitators and teachers' presence in learning mathematics courses through online environment. The obtained level of student satisfaction in this type of interaction validates the study of Croxton (2014) stating that learner-teacher interaction is a primary variable in student satisfaction with online learning. However, the students expressed frustration by the lack of feedback from their mathematics teacher leading to low student learning engagement (Obenza-Tanudtanud & Obenza, 2023). This study supports the importance of teachers' presence especially in teaching and learning mathematics in online classes. Creating interaction between learner and teacher, either one-on-one interaction or interaction between a teacher and a group of learners, may provide students a sense of belongingness and stability in an online learning environment (Croxton, 2014).

The level of satisfaction among the students in terms of learner-learner interaction is at satisfied level as indicated by their agreement expressing their ability to ask for clarification from a fellow student or peer when needed. Mathematics online courses encouraged them to discuss ideas and concepts covered with other students. This finding on learner-learner interaction suggests that for a satisfying online learning experience, students should feel a sense of community among them. This is consistent with the prior study that a strong student-student interaction in an online learning environment fosters social presence, in turn, social presence leads to a more satisfying online experience (Strauß & Rummel, 2020).

Learner-interface interaction could also explain the satisfaction level of students in General Education mathematics courses through an online learning environment. The students interacted with Canvas as a learning management system or the interface for online learning. The modular learning activities can be accessed by the students in the Canvas. The results of the study revealed that they were satisfied with their interaction with the learning management system. It indicates that the students recognized the functionality of the institutional learning management system. This finding is supported by the students' consensus expressing confidence in their abilities to utilize the learning management system and awareness on making their learning mathematics courses easier using some computer packages embedded in the Canvas. Their satisfaction level with online learning through a learning management system may be explained by their ability to easily use the Canvas and to deal with the difficulties they encounter when using the Canvas and their positive attitude towards the Canvas as a good aid for

learning (Strachota, 2006). Enhancing the learning platform may increase students' satisfaction with online learning (Zhou, 2024).

Based on the results of the study, it appeared that the four types of interaction contributed to a satisfying online learning experience in mathematics courses. These types of interactions are significant predictors of student satisfaction and positively related to achievement outcomes in distance education (Doo et al., 2019) although learner-learner interaction may be negligible in online settings. However, the learner-interface interaction least contributed to overall student satisfaction with online learning. This finding supports the idea that technology-related factors may impact student satisfaction with online learning (Elshami et al., 2021; Strachota, 2006). The low students' level of satisfaction per interaction may be explained by their disagreement on items describing a satisfying online learning experience when interacting with the content, their teacher, their peers, and the learning management system. Most of the items that obtained the low mean satisfaction rating are pertinent to learner-interface interaction. Based on the results of the study, the students reported low means satisfaction rating in items expressing the following: (a) the use of learning management system makes online learning more interesting, (b) the learning management system makes students much more productive, (c) enjoyment in working with the learning management system, (d) assessment of students computer skills, (e) ability to deal with difficulties encountered when using the learning management system, and (f) the easiness of working with the learning management system.

In terms of learner-teacher interaction, items stating students' frustration by the lack of teacher's feedback and the acquisition of individualized attention from their teacher obtained the lowest mean satisfaction rating. The item expressing their feeling in improving their mathematical skills through online learning obtained the least mean satisfaction rating in the learner-content interaction, while the item expressing timely feedback received from other students. obtained the least mean satisfaction rating in the learner-learner interaction. These findings suggest that there is still room for increasing the level of student satisfaction with online learning in General Education mathematics courses by giving attention to above-mentioned items, especially in terms of learner-interface interaction. In the Weerasinghe et al.'s (2017) literature review, several studies revealed that student interaction with fellow students, available online learning tools, teachers, and course material had a significant impact on university student satisfaction. Thus, satisfaction with online learning increases as these types of interaction are applied within the online learning context. Elshami et al. (2021) highlighted students' suggestions for improving student satisfaction with online learning. Some of these strategies include the integration of other applications that engage students in learning (e.g., games, surveys), scheduling of academic advising and consultation hours, communication with students before synchronous classes, and more online discussion supplemented by timely feedback from teachers.

General satisfaction was also included to measure if the overall needs of the students in online learning have been met. In general, majority of the students were at satisfied level with online learning in General Education mathematics courses. The level of satisfaction may be explained by their consensus expressing their desire to recommend online mathematics courses to other students. However, predominance of disagreement and strong disagreement on the effectiveness of online mathematics courses as compared to face-to-face courses suggests dissatisfaction with online learning. Furthermore, the findings reveal that the students who were enrolled in General Education additional mathematics courses were not satisfied with learning the mathematics courses online. Student dissatisfaction with online learning may be due to acquisition of learning needs and their preference with face-to-face learning mode. This finding is coherent with the previous study that mathematics learners prefer face-to-face learning mode (Krishnan, 2016). In face-to-face instruction, students are more comfortable interacting with their peers and the teachers, and they learn and understand the mathematics concepts better. The lack of real-time feedback and face-to-face communication led to social isolation and decreased interest in learning (Dipolog, 2022).

The results provided supporting evidence that students enrolled in face-to-face learning were more satisfied than their online counterparts in higher education context (Tratnik et al, 2017). Students may perceive that online learning is not "real" learning (Formoso, 2018). Based on their responses, majority of them expressed that they

would not like to take another online course, the online courses did not meet their learning needs, they did not learn as much in online course as compared to face-to-face learning, and the online courses are not effective as face-to-face learning.

The results reveal that majority of the students were overall satisfied with online learning in General mathematics courses. The distribution of the students' satisfaction ratings in both General Education core mathematics course and additional mathematics courses provided the explanation where most of them were at the satisfied level. This finding is consistent with the claim that students reported overall satisfaction with online instruction (K. Tolentino, personal communication, June 18, 2020). Further, this pattern of results is consistent with the previous literature that reported the same level of satisfaction with online learning (Shaid et al., 2021). On the other hand, the proportion of dissatisfied or very dissatisfied with online learning is larger in the group of students who took up General Education additional mathematics courses. These results suggest that the proportion of respondents enrolled in General Education core course who were at least satisfied with online learning is greater than the proportion of the respondents enrolled in General Education additional mathematics courses.

The study compared the satisfaction of first year level and second year level students studying General Education core mathematics course since this course was mandated to all undergraduate students. The researcher obtained evidence that, although the first-year students reported higher satisfaction rating with online learning in General Education core mathematics course than the sophomores, there was no statistically significant difference in the overall student satisfaction with online learning in the core course according to the year level. Further, the study compared the overall satisfaction with online learning of students enrolled in General Education core mathematics course and students enrolled in General Education additional mathematics courses. A statistically significant difference in the overall satisfaction with online learning was found in favor of General Education core mathematics course students. This finding is supported by the substantial proportion of students enrolled in General Education mathematics additional course who reported dissatisfaction with online learning.

The results of the study showed that in all types of interaction, the students who were enrolled in the General Education additional mathematics course obtained lower mean satisfaction rating than the students who were enrolled in core mathematics courses. The learner-content obtained the lowest mean satisfaction rating for General Education additional mathematics course group. In terms of general satisfaction, they reported a level of dissatisfaction. This dissatisfaction with online learning may be attributed to course content. This may be problematic for mathematics courses such as Linear Algebra, Probability and Statistics, and Calculus because of course content difficulty. Moreover, the significant difference in satisfaction with online learning may be influenced by factors such mathematics curriculum prior to the students' undergraduate education and preference of face-to-face learning mode (Krishan, 2016). Another crucial factor for dissatisfaction could be credited to the sudden shift from face-to-face to online delivery of the instruction due to Covid-19 pandemic (Elshami et al., 2021; Tanguihan 2024), accompanied by stressful learning conditions of the pandemic itself.

6. Conclusions

The study investigated student satisfaction with online learning in General Education mathematics courses. The sample was limited to one university at one point in time which any generalizations drawn from this study should be considered with caution. This study revealed that the level of student satisfaction with online learning in General Education mathematics courses could be considered as an important indicator for successful result of online learning initiatives in mathematics education. The study may provide baseline data for planning and policy evaluation of a model of online delivery of education. This study highlighted the importance of types of interaction in online learning in promoting student satisfaction in learning mathematics. The findings offer clear support for how students interact with the course content, their teacher, their peers, and the learning management system provided satisfying online experiences in mathematics courses. Important to the findings of the study is the need for mathematics teachers to design online learning activities in the learning management system to make online learning interesting, productive, and enjoyable. Likewise, identification of appropriate approaches and strategies

in increasing the level of student satisfaction with online learning based on the interactivity of online learning is critical in providing satisfying online learning experiences.

The students felt that online courses are not as effective as face-to-face courses. Thus, careful attention to general satisfaction with online learning must be paid by mathematics teachers. Mathematics teachers must design activities based on the interactive functions of online learning to increase student satisfaction. Moreover, the findings revealed that there was no significant difference in satisfaction rating with online learning in the General Education core mathematics course in terms of their year level. It can be concluded that the core course Mathematics in the Modern World may be offered during the first year or second year stay of the students in the undergraduate program. On one hand, a statistically significant difference in the overall satisfaction with online learning was found in favor of General Education core mathematics course students over additional mathematics courses. The sudden shift from face-to-face learning to online learning brought about challenges concerning the effectiveness of delivery of instruction of these additional mathematics courses wherein the nature of course content is more abstract than the core mathematics course. Source of student dissatisfaction with online learning in General mathematics courses may be attributed to the content of the course and interactive functions of the learning management system. Migration from traditional or face-to-face learning to online learning environment has important implications for the way students learn mathematics courses. This is especially true on how they interact with the course content, teacher, and other students. With their previous learning experiences in mathematics courses, students would prefer to attend classes on campus. At the same time, online courses may divert students who prefer face-to-face learning to find online learning satisfying.

Implications - The findings have several practical implications for higher education institutions. Administrators and instructional designers should ensure that online mathematics courses are developed with engaging and well-structured content, effective feedback mechanisms, and accessible learning platforms. Continuous professional development programs for faculty should be implemented to strengthen their skills in online pedagogy, feedback provision, and technology integration. Institutions must also provide adequate technical support to both teachers and students to maintain smooth and interactive online learning environments. For mathematics educators, the findings emphasize the need to foster strong learner-teacher and learner-content interactions. Teachers should use varied instructional strategies, such as problem-based learning, discussion forums, and interactive assessments, to enhance participation and understanding. By improving feedback systems and sustaining teacher presence in online classrooms, teachers can create a more engaging and motivating virtual learning experience for students. For students, the study highlights the importance of developing self-management and digital literacy skills to adapt effectively to online learning environments. Students must take active roles in their learning by maintaining discipline, time management, and active participation in online discussions. Recognizing the functionality of the learning management system and using it as a tool for collaboration and problem-solving can enhance their overall satisfaction and learning outcomes.

In summary, the study contributes valuable insights into understanding how student satisfaction in online learning can be improved through well-designed course content, meaningful interaction, and institutional support. These findings provide a strong foundation for refining online teaching practices in mathematics education and for ensuring that future learning environments remain learner-centered, interactive, and responsive to students' academic needs.

7. References

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