International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.849 ISSN: 1308-5581 Vol 14, Issue 05 2022

PRESERVICE TEACHERS' ATTITUDE TOWARDS LEARNING MATHEMATICS WITH TECHNOLOGY: INPUT FOR MATHEMATICS INSTRUCTION

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Abstract

This study examined the complex interactions among students' gender, year level, Mathematics confidence (MC), affective engagement (AE), behavioral engagement (BE), confidence in using technology (TC) and attitude to the use of technology to learn Mathematics (MT). Using the Mathematics and Technology Attitudes Scale (MTAS), one hundred seventy-three Bachelor of Secondary Education students major in Mathematics were explored. The mean, t-test for independent sample and Analysis of Variance were utilized to analyze the data gathered. The results revealed that respondents' attitudes toward utilizing technology to learn Mathematics and their affective involvement were highly positive, and that their attitudes toward Mathematics confidence, behavioral engagement, and confidence in using technology were likewise positive. In addition, it was also shown that when respondents were categorized according to sex, there was no notable difference in their attitudes on studying Mathematics using technology. Furthermore, when respondents were categorized according to year level, there were observable disparities in their views toward using technology to study Mathematics. Classrooms are equipped with various technology as a result of the constantly evolving technological landscape. Thus, with technology being a fundamental element of education, the technology-based tools should be integrated in the Mathematics curriculum to foster student learning.

Introduction

Information and communication technology (ICT) has evolved into one of the most important components of modern society. Numerous countries consider acquiring the fundamental skills and concepts of information and communication technology to be an integral part of our educational system. With the inclusion of ICT in the school curriculum, students are now expected to use ICT effectively in their courses, regardless of the subject, they are studying. In response to the new opportunities that are becoming available as a result of integrating ICT into the teaching and learning environment, a variety of new educational models are emerging.

Technology in the form of'Mathematics analysis tools' such as computer softwares, graphics calculators, computer algebra systems, spreadsheets, and statistics programs can help students explore mathematical concepts, solve problem, and develop metacognitive abilities in learning and doing Mathematics.

Furthermore, information technology in the form of' real world interfaces, such as digital cameras, video cameras, and data loggers, can bring the outside conditions to which Mathematics is applied to life in the classroom. Withsignificant investment in providing information technology to aid in the teaching and learning of Mathematics, it is critical to observe students' reactions and determine how best to employ both forms of technology, mathematical analytical tools and real-world interfaces.

Technology opens up innovative teaching and methods across the Mathematics curriculum. The new approaches may improve learningthrough cognitive, metacognitive, and affective channels. The introduction of technology and its widespread use in commerce and industry, as well as in schools, made school-related jobs easier. Its existence has also made Mathematics more important in terms of teaching and learning, especially in light of the COVID-19 pandemic.In response to continuous global reforms in society's educational and technical advancement, teachers should explore on the use of different technologies that can aid in the teaching of Mathematics.

Teachers can create strong collaborative learning experiences that enhance problem solving and flexible thinking by incorporating technology into Mathematics classrooms. Students and teachers can design their learning together in genuine ways that improve Mathematics learning by strategically integrating both content-specific and content-neutral technology.

There is evidence of a link between computer-supported leisure activities, favorable attitudes toward Mathematics, advancement in mathematical learning, and student achievement through technology in education, according to Rosas (2003). Similarly, Jonanssen (2000) claims that technology can be used to facilitate the deep analytical thinking required for effective learning.

Computers, which are regarded the most powerful interactive platform and the most powerful individual learning technology, have permeated educational systems and produced new approaches to school systems and learning processes, according to Usun (2004). Computer technology, according to Monaghan (2004), provides new mathematical domains and brings new methods of thinking about Mathematics with it. The successful use of information technology in Mathematics education is a topic that has received a lot of attention (Cockcroft, 1982).Furthermore, according to López-Martio and López (2007), the electronic learning environment is centered on Interactive Instructors of the International Institute of Recreational Mathematics (IIRM) has a favorable impact on students' attitudes toward Mathematics.

The educational technology industry is swamped with new apps, tech tools, and gadgets, and teachers are sometimes praised for more technology use, whether or not it fosters healthy math learning. Although technology can have a positive impact on student learning, it should not be used to substitute teaching or to disregard research-based best practices in math instruction.

Today's students are adept with technology and are accustomed to using devices like computers, cellphones, and tablets which are commonplace in today's classrooms. Students do not only use these gadgets to maintain social connections, but the world around them is also constantly connected to the internet of things.Teachers are interacting with a generation that is obsessed with technology, and many of them are utilizing it to improve learning. Taking technology out of the classroom would mean taking away a crucial component of the students' abilities and skills.As a result, educators must start preparing their students for a world in which mastering technology is not a choice but rather a requirement.

The 21st-century learning process heavily incorporates education technology. Nevertheless, integrating educational technology into the classroom is not always easy or successful. Many teachers and administrators encounter challenges that keep them from finding, installing, and utilizing technology that they can employ to improve students' education.

Rosas (2003) found evidence of a relationship between computer-supported leisure activities, favorable attitudes toward Mathematics, advancement in mathematical learning, and student achievement using technology in the classroom. Similar to this, Jonanssen (2000) contends that technology can help students develop the critical thinking skills necessary for successful learning.

According to Rahman, Ghazali, and Ismail's (2003) Technology Acceptance Model, the intention and, eventually, the actual use of computers in the classroom environment were positively correlated with the attitude toward employing computer technology.Since most learning modalities require the use of technology, the researcher put importance on students' attitudes toward the use of technology in teaching Mathematics.Gaining insights into students' attitudes and beliefs is a crucial step in understanding how the learning environment for Mathematics is affected by the introduction of computers and other technology.The cognitive and metacognitive routes for employing technology to improve learning are clearly powerful and important to investigate. The Mathematics and Technology Attitudes Scale (MTAS) isused in this work to investigate the role of the affective channel, which is also important.

There are five affective variables connected to technology-based learning Mathematics in the Mathematics and Technology Attitude Scale (MTAS) developed by Pierce, Stacey, and Barkatsas (2007). The five sub-scales are Mathematics Confidence (MC), Technology Confidence (CT), Attitude to Learning with Technology Mathematics (ALMT), Affective Engagement (AE), and Behavioral Engagement (BE).

COVID-19 has disrupted many countries' educational systems. The looming threat of the COVID-19 pandemic forced the closure of primary and secondary schools, as well as colleges and universities. Face to face classes switched to distance learning (online format), with no in-person classes being held (Unger &Meiran, 2020).The Department of Education (DepEd) and State Colleges and Universities (SUCs) in the Philippines are still adamant about the best delivery option for students to learn. Aware of the threat of contamination from the virus continued spread, smart actions are being implemented. Different modalities were explored, such as the modular approach, online learning, and blended learning, but schools are still undecided about the appropriate mode to use to make learning accessible to learners at all levels across the country.

During the pandemic, teachers, especially Mathematics teachers, must be capable of using technology in the new modality of teaching and learning. Theyadapt their teaching methods to the new normal, especially when internet tools and resources provide various chances for both teachers and students. However, the Organization for Economic Cooperation and Development's (OECD)(2016) research on the use of teaching and learning technological devices could be a good place to start when it comes to addressing how to effectively use online tools

DOI:10.9756/INTJECSE/V14I5.849 ISSN: 1308-5581 Vol 14, Issue 05 2022

in remote or distance learning. Even with technology learning materials, the famous study demonstrated that studentsdid not naturally perform better. The study found that teachers were not appropriately and meaningfully incorporating technology tools because they were not prepared in 21st-century pedagogy.

According to Pierce Stacey and Barkatsas (2007), faith in the use of technology, attitude toward technology-based learning Mathematics, and affective and behavioral interaction are all linked to the efficacy of learning processes.Likewise, Ingram (2015) and Kele& Sharma (2014) pointed out that students' attitudes have a critical influence in Mathematics learning. Thus, teachers of Cagayan State University, particularly Mathematics teachers, must determine the attitude of students towards learning Mathematics with technology in order to successfully employ technology-based activities in the classroom.

The International Society for Technology in Education (ISTE, 2007) and the National Council of Accreditation of Teacher Education (NCATE, 2002) both support the use of technology in education and believe that students should be given opportunities to participate in technology-supported activities that enrich their learning. Thus, the research aimed to determine the attitude of the students towards learning Mathematics with technology in order to figure out ways to appropriately incorporate technology into instructional plans that maximize student participation and provide a value-added impact on Mathematicsperformance of students.

Statement of the Problem

Technology provides a wide range of possibilities for innovative approaches to Mathematics education that can improve learning in cognitive, affective, and psychomotor domains. With considerable investment in providing information technology to aid in the teaching and learning of Mathematics, it's critical to investigate into students' reactions and figure out how to best employ technology in mathematical analysis and real-world problems.

Thus, this study aimedto track the attitudeof students in their learning engagement of Mathematics to consider how best the use of technology can be implemented. The following questions were explicitly targeted for this research's search for solutions:

1. What is the profile of the respondents in terms of
a. gender
b. year level
2. What is the attitude toward learning Mathematics with technology in terms of:
a. Mathematics confidence (MC),
b. affective engagement (AE),
c. behavioral engagement (BE),
d. confidence in using technology (TC), and
e. use of technology to learn Mathematics (MT)
3. Is there a significant difference in the attitude toward learning Mathematics with technology when grouped according to the profile of the respondents?

Methodology

Research Design

The descriptive-inferential research design was used for the investigation. Since the study was concerned with evaluating the respondents' attitudes about learning Mathematics in terms of mathematical confidence, affective engagement, behavioral engagement, confidence in using technology, and using technology to learn Mathematics, this design was employed. Furthermore, the study was inferential because it examined the differences in respondents' attitudes regarding studying Mathematics with technology when they were grouped based on profile factors.

Respondents of the Study

This research was conducted at Cagayan State University, a state university in Cagayan Valley, Philippines. Cagayan State University comprises of 8 campuses, dispersed over the province, namely: Aparri, Lal-Lo, Gonzaga, Piat, Lasam, Sanchez-Mira, Andrews and Carig. More specifically, the first year to fourth year Bachelor of Secondary Education students specializing in Mathematics of the College of Teacher Education's Andrews Campus in Tuguegarao City, where the researcher is based, provided the data for the study.

Data Collection Tools

The Mathematics and Technology Attitudes Scale (MTAS) developed by Barkatsas, et.al. (2005) was used in this study to explore the role of the affective channel for enhancing learning.The test includes five subscales that

DOI:10.9756/INTJECSE/V14I5.849 ISSN: 1308-5581 Vol 14, Issue 05 2022

enabled the researcher to track the following five variables: Mathematics confidence (MC), affective engagement (AE), behavioral engagement (BE), confidence in using technology (TC) and attitude to the use of technology to learn Mathematics (MT).

Data Analysis

The collected data was organized, examined, and interpreted in line with the goals of the study.The respondents' demographics were summed up using frequency count and percentage while their attitudes toward learning Mathematics with technology were evaluated using the weighted mean. The resulting means were further interpreted using the provided scales.

Mean	Descriptive Value
4.20 - 5.00	Highly Positive
3.40 – 4.19	Positive
2.60 – 3.39	Neutral
1.80 – 2.59	Negative
1.00 – 1.79	Highly Negative

The hypothesis of the study was tested using inferential statistical techniques like the t-test for independent samples and the Analysis of Variance.

Results and Discussion of Findings

1. Profile of the Respondents

Table 1.a Frequency and Percentage Distribution of Respondents in Terms of Sex

Sex	Frequency	Percent
Male	41	23.70
Female	132	76.30
Total	173	100

As seen in the table, there are 132 respondents or 76.30 percent of them are women, compared to 41 respondents or 23.70 percent of them are men.This statistic demonstrates unequivocally that females outnumber males in teacher education courses.The belief that teaching should be seen as an extension of adults' work with their own children, which is still conducted more frequently by women than men, is typically used to explain the numerical dominance of women in education professions.

Table 1.b Frequency and Percentage Distribution of Respondents in Terms of Year Level

Year level	Frequency	Percent
First Year	55	31.79
Second Year	45	26.01
Third Year	43	24.86
Fourth Year	30	17.34
Total	173	100

According to the data, 55 or 31.79% of the respondents are first-year students. Only 30 respondents, or 17.34 percent, are in their fourth year.The information indicates that more first-year students choose Mathematics as their field of specialization. As they advance to higher year levels, however, the enrollment falls.This is due to the qualifying exam that was given to them after their first year in the college. Students in their first year take the exam to see if they qualify to continue their studies in their second year. Students are shifted to other courses in the event that they do not pass the exam. Additionally, some students discontinued their studies because of their financial circumstances.

2. Attitude toward Learning Mathematics with Technology

Table 2. Item Mean and Descriptive Value of the Attitude toward Learning Mathematics with Technology

DOI:10.9756/INTJECSE/V14I5.849 ISSN: 1308-5581 Vol 14, Issue 05 2022

Dimensions	Mean	Descriptive Value
Mathematics Confidence (MC)	3.85	Positive
Use of Technology to Learn Mathematics(MT)	4.20	highly positive
Confidence in using Technology (TC)	3.49	Positive
Behavioral Engagement (BE)	4.19	Positive
Affective Engagement (AE)	4.47	highly positive

The table demonstrates that, with a mean of 4.20 and 4.47, respectively, the use of technology to learn Mathematics (MT) and affective engagement was evaluated "highly positive."

Furthermore, the table also highlights the fact that confidence in employing technology(TC) had the lowest mean of 3.49 with a descriptive value of "positive".

The result suggests that students are utilizing technology for all types of information retrieval, communication, research, data modification, and analysis. However, they find it challenging to consistently learn how to master new technology due to the constant expansion of new apps and devices, and eventually feel stuck.

3. Test of significant difference in the attitude toward learning Mathematics with technology when grouped according to the profile of the respondents

Table 3. Test of Significant Difference on the Attitude toward Learning Mathematics with Technology of the Respondents when Grouped According to Sex

Dimensions	sex	Mean	Std. Deviation	t-value	p-value
Mathematics Confidence (MC)	FEMALE	3.8201	.56733	-1.164	0.246
	MALE	3.9451	.69936		
Use of Technology to Learn Mathematics (MT)	FEMALE	4.2538	.64425	1.762	0.080
	MALE	4.0366	.82075		
Confidence in using Technology (TC)	FEMALE	3.4545	.67523	-1.204	0.230
	MALE	3.6037	.74786		
Behavioral Engagement (BE)	FEMALE	4.1913	.58272	0.128	0.899
	MALE	4.1768	.77710		
Affective Engagement (AE)	FEMALE	4.4754	.59327	0.320	0.749
	MALE	4.4390	.75370		

The mean attitude toward using technology to learn Mathematics is broken down by gender in Table 3. The table shows that females had higher means than males on the characteristics of behavioral engagement (BE), affective engagement, and use of technology to learn Mathematics (MT). While boys' mean scores on the Mathematics confidence (MC) and confidence in using technology (TC) are even more strongly higher than girls. These findings confirm the widespread observation that boys exhibit higher levels of confidence than girls, but they differ with those of Vale and Leder (2004), who discovered gender differences exclusively in their variable equivalent to MT.

The p-values for mathematical confidence (MC), technology use to learn Mathematics (MT), technological confidence (TC), behavioral engagement (BE), and affective engagement (AE) are further revealed in the table and are, respectively, 0.246, 0.080, 0.230, 0.899, and 0.749 at the.05 level. This indicates that, when respondents were categorized according to sex, there was no notable difference in their attitudes on studying Mathematics using technology. This implies that sex of the respondents do not influence their attitude toward learning Mathematics with technology.

Table 4. Test of Significant Difference on the Attitude toward Learning Mathematics with Technology of the Respondents when Grouped According to Year Level

Dimensions		Sum of Squares	df	Mean Square	F	p-value
Mathematics Confidence (MC)	Between Groups	3.797	3	1.266	3.662	.014
	Within Groups	58.420	169	.346		
	Total	62.217	172			
Use of Technology to	Between Groups	4.336	3	1.445	3.113	.028

Learn Mathematics (MT)	Within Groups Total	78.458 82.794	169 172	.464		
Confidence in using Technology (TC)	Between Groups Within Groups Total	4.945 77.850 82.795	3 169 172	1.648 .461	3.578	.015
Behavioral Engagement (BE)	Between Groups Within Groups Total	3.590 65.054 68.645	3 169 172	1.197 .385	3.109	.028
Affective Engagement (AE)	Between Groups Within Groups Total	4.762 64.109 68.871	3 169 172	1.587 .379	4.185	.007

The table shows the p-values for mathematical confidence (MC), technology use to learn Mathematics (MT), technical confidence (TC), behavioral engagement (BE), and affective engagement (AE), which are, respectively, 0.014, 0.028, 0.015, 0.028 and 0.007 at the.05 level. This illustrates that when respondents were categorized according to year level, there were observable disparities in their views toward using technology to study Mathematics. The different year levels have distinct meanings for each dimension. This suggests that their attitude toward learning Mathematics is influenced by their year level.

Conclusion

Technology is becoming a crucial component of modern education since students need to be ready for the workforce of the twenty-first century. Incorporating technology in the teaching of Mathematicspresent obstacles for educators.In spite of the demands and challenges experienced by teachers in teaching Mathematics in the new normal education, teachers are still positive towards teaching with technology to bring meaningful learning to the students. This is due to the fact that the attitudes of respondents regarding using technology to study Mathematics and their affective participation were very favorable, and that their attitudes toward mathematical confidence, behavioral engagement, and confidence in using technology were also very positive. Moreover, students have increased expectations for digital learning and teaching methods due to the pervasiveness of technology in daily life. Thus, technology must be a fundamental part of today's educational contexts since technology-based tools can improve student performance when they are incorporated into the curriculum.

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Yogesh Hole et al 2019 J. Phys.: Conf. Ser. 1362 012121

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