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Pre-service Mathematics Teachers Online Teaching Training Using Authentic Learning Activities: It's Effect on Their Online Teaching Self-Efficacy

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Abstract The availability of more online courses has led to an increase in online learning options and blended learning approaches. These developments brought to light the need to equip preservice teachers with the knowledge and abilities to design online classes and activities and improve their abilities to control student behavior in online learning. This study sought to determine the effects of authentic learning tasks on preservice teachers' self-efficacy in online teaching. The researchers assessed the effect of authentic learning activities on preservice teachers' self-efficacy for online teaching using single group pretest-posttest experimental design .Data were collected using a modified version of The Michigan Nurse Educators' Sense of Efficacy for Online Teaching Scale (MNESEOT) by [1] and the "Survey of Online Teaching Perception" questionnaire. A total of 32 third-year preservice teachers who were enrolled in a *Principles and Strategies of Teaching Mathematics* course participated in the study. The findings demonstrated that authentic activities significantly improved preservice teachers' online teaching self-efficacy scores in the areas of student engagement, instructional techniques, classroom management, and computer abilities. The results of the study demonstrate that pre-service teachers had a high level of confidence in their capacity to carry out authentic learning tasks such creating websites, maintaining blogs, directing synchronous classes, and planning presentations. Also, despite their initial hesitation brought on by their lack of experience, the pre-service mathematics teachers felt confidence in their capacity to conduct online instruction. The connection of authentic learning exercises to real-world situations increased their degree of comfort with future online education.

Keywords: *authentic learning tasks, online teaching self-efficacy, online instruction*

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1. Introduction

The COVID -19 pandemic has presented challenges to every sector of society. The education sector is one of the sectors that is highly affected in this global crisis. According to United Nations Educational, Scientific and Cultural Organization (UNESCO) this global crisis affected more than 1.5 billion students and youth across the planet caused by school and university closures. Among this number are over 28 million Filipino learners across academic levels who have to stay at home and comply with the Philippine government's quarantine measures [2]. As a result, education has changed dramatically, and millions of learners must [3] adopt to new types of learning, with the distinctive rise of e-learning, whereby teaching and learning is undertaken remotely and on digital platforms. As there are various definitions of e-learning, this study defines e-learning as a term that refers to a course that is completed fully online. There is no face-to-face interaction between the teacher and the students. Email, forums, chat, and video conferencing are used for all course work and communication.

As the majority of educational systems worldwide have shifted to remote learning as a preventative step against the spread of the COVID-19, teachers were forced to adjust to new teaching paradigms. Teachers were forced to adapt to e - teaching, which required them to use a variety of digital tools and resources to address problems and adopt new teaching and learning strategies, change their teaching approaches and manage their time. These problems raise crucial questions about instructors' online teaching approaches during this period of unforeseen change and upheaval in education. According to a study by Nketsia [4], preservice teachers require extensive ICT training in order to be prepared for online teaching. Preservice teachers cannot build technological competencies and adopt these into their teaching practices if they are not exposed to do so throughout their teacher education courses. [5]

The aim of this work is to design authentic learning activities for preservice mathematics instructors' online

teaching training to remedy this deficiency. Authentic learning designs have been shown to increase student engagement and academic outcomes. It accomplishes this by encouraging learning activities and assessments that adhere to the authentic e-learning principles [6]: real-world relevance, ill-defined problems, sustained investigations, multiple roles and perspectives, collaborative knowledge construction, interdisciplinary perspectives, integrated assessments, and plenty of opportunities for reflection. [6]

Self-efficacy is an important characteristic for success in online education. Studies in the field of education reveal that teaching self-efficacy is crucial to instructors' performance because it foretells their capacity to put up with and overcome the insurmountable difficulties that come with understanding online teaching. In the face of the accelerating expansion of online learning offerings across higher education, deficits in online teaching self-efficacy present a challenge that threatens the quality of educational offerings to todays and future students. One way for higher education institutions to support teachers' transition to online teaching may be to improve their online teaching self-efficacy.

Teachers tend to feel less self-efficacious when it comes to online teaching due to the difference between real and virtual classroom conditions [7]. University faculty members with experience teaching online were shown to be more motivated to teach online [8].

Therefore, in this study, the impact of the authentic learning activities to the online teaching self-efficacy of preservice mathematics teachers was examined.

2. Theoretical Framework

2.1. Authentic Learning Framework

Authentic learning as defined by Pearce [9] is a learning designed that connects what students are taught in school to real-world issues, problems, and applications: learning experiences should mirror the complexities and ambiguities of real life. The most important benefit offered by authentic learning is that it prepares students for real world more effectively than traditional classroom-based learning [10]. Because of this, a concomitant trend is toward designing authentic learning environments. It is not a new concept to teach mathematics in a way that explicitly relates mathematical concepts, skills, and strategies to purposeful, relevant, and meaningful situations, resulting in a higher level of understanding in the classroom. Various national and international organizations and standards have endorsed this, such as the National Council of Teachers of Mathematics [11], which emphasizes the goal of developing standards that enhance knowledge and application of mathematics in everyday life and the workplace. The National Mathematics Advisory Panel's study from 2008 urged for the use of real-world contexts to introduce mathematical concepts. The study discussed early findings that lesson instruction with real-world situations has a favorable impact on some types of problem solving for populations and for specific domains of mathematics such as fractions, basic equations, and functions. Authentic learning is a successful educational method because it requires learners to create connections to prior knowledge and to investigate new information in context [12]. The contextual character of the experiences fosters deeper learning by associating them with a setting, activities, and people, thus bridging the divide between theoretical knowledge and real-world application. [13]

Multiple frameworks have developed to understand authentic learning. Among the frameworks that were developed, the authentic learning framework by [14] suggested that authentic learning can be delivered in a learning environment that features the following design elements in their authentic learning framework. These are: (1) Provide authentic activities that will be used in real life, (2) Provide Authentic activities that require students to define the tasks and sub-tasks needed to complete the activity, (3) Provide authentic activities comprising complex tasks to be investigated by students over a sustained period of time, (4) Provide authentic activities which provide the opportunity for students to examine the task from different perspectives, using a variety of resources, (5) Provide authentic activities that offer opportunity for collaboration, (6) Provide authentic activities that promote reflection allowing abstraction to be formed, (7) provide authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes, (8) Provide authentic activities that integrate assessment with learning tasks, (9) Provide authentic activities that promote articulation to enable tacit knowledge to be made explicit, and (10) Provide authentic activities that allow competing solutions and diversity of outcome.

2.2. Self-Efficacy and Teacher Self-Efficacy

From a social-cognitive perspective, self-efficacy refers to an individual's perception of their capacity to execute predictable daily tasks, which influences their decision-making. Those with high efficacy are more likely to set more difficult goals, are more resilient, and experience less unpleasant emotions during the process of accomplishing their goals [15]. Self-efficacy is a significant component in a teacher's personal goals, their persistence when things don't go their way, and their motivation to do specific things in the classroom, such as employing digital teaching tools [16]. According to reports, instructors with a higher TSE are more likely to feel involved with their students and to enjoy more job satisfaction [17]. In addition, they are typically more tenacious in the face of difficulty and more inventive in their efforts to help students comprehend difficult subject matter [18]. Similarly, preservice teachers' lifelong learning competencies are influenced by their self-efficacy for educational technology standards [19].

It was shown that university instructors with prior online teaching experience were more likely to express greater motivation to teach online [8]. Individuals without prior online teaching experience reported decreased self-efficacy while shifting to online teaching [20].

Self-efficacy in online instruction might be enhanced, and a variety of elements were cited as having an impact on its development. TSE for using technology to online teaching and developing an online teaching environment

was the most worrisome among a cohort of teachers whose TSE for online instruction increased after finishing an online teacher education program [21].

Self-efficacy beliefs and goal orientations have a substantial effect on the educational practices of teachers. Teachers are one of the most crucial elements of the educational system. According to [15] their views and attitudes during their training as educators influence their behavior as educators. Current research in the subject of education demonstrates that knowledge and abilities alone are insufficient for effective teaching. It has been discovered that teachers' attitudes and beliefs contribute to their efficacy as educators. Even though there are several studies on student motivation for learning, there has been very little research on a teacher's motivation for teaching [22]. In addition to a lack of research on teacher motivation, there are also very few studies on developing teachers' or preservice teachers' beliefs about technology integration after a course or educational preparation program. Therefore, it is necessary to look at pre-service teachers' development of beliefs about technology integration [20]. Bandura theorized self-efficacy and defined perceived self-efficacy as a "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" [15] Self-efficacy beliefs have an influence on a person's behavior. For example, people who have a high self-efficacy belief tend to choose challenging work, engage in work, and persist through it. Bandura [23] stated that perceived self-efficacy is related to the emergence of behaviors and is important for developing new behaviors.

3. Objectives of the Study

In this study, the impact of authentic learning tasks in training preservice teachers about online teaching on their online teaching self-efficacy was investigated. The research questions for this study were as follows:

a) What degrees of online teaching self-efficacy do mathematics preservice teachers exhibit prior to and following authentic learning activities?
b) What is the impact of authentic learning activities on preservice teachers' self-efficacy in online teaching?
c) To what degree do demographic impact mathematics preservice teachers' levels of online teaching self-efficacy in general and in the following sub-scales of online teaching self-efficacy: online student engagement, online instructional strategies, online class management, and the use of computers?
d) What was the Preservice Teachers' perception of their learning experiences?

4. Methods

The repeated measures pretest-posttest design was used for this investigation. Prior to and following the completion of the authentic learning activities concerning online teaching, participants are tested. A research environment was developed because experimental designs seek to investigate cause and effect relationships. The impact of the authentic learning activities in preparing preservice teachers for online teaching was determined using this technique.

Design-based research (DBR) was carried out in this study by utilizing the framework for authentic learning in instructional activities geared on training preservice teachers to teach online.

A revised version of the Michigan Nurse Educators' Sense of Efficacy for Online Teaching Scale (MNESEOT) by [1] was used to collect data on the online teaching self-efficacy of pre-service teachers at the outset of the project. The 32-item MESEOT scale asked participants to respond to items using a Likert-scale format ranging from no confidence (0) to complete confidence (10) in relationship to questions about online teaching. It was administered to the mathematics preservice teachers online prior to the start of class in order to construct more authentic learning activities and obtain a deeper understanding of the needs and characteristics of the students.

The pre-service teachers were then exposed to the authentic learning tasks. They were instructed that they cannot conduct face to face classes because of a pandemic for a month. The pre-service teachers were told to use Google sites, Google's website builder, to build a month-long online course for that student. Learning activities must include four weeks of instruction supporting topics in Senior High School Math Curriculum of the Department of Education. The learning tasks should be enhanced by various technical web applications. The participants had two weeks to learn how to make websites using online tutorials and videos, after which they had three weeks to create the online course. After finishing the website, participants were told to examine the websites of two of their colleagues and utilize screen-capture software to give feedback to other participants. Synchronous meetings were also held throughout the course of the three weeks, at which time other topics including blogging and how to successfully create and teach an online course. They also had an opportunity to practice using asynchronous and synchronous discussions to maximize interaction between students in an online class. Students were given prompts to reflect on the authentic activities on the blogging platform and by responding to the Survey for Online Teaching Perception questionnaire. A background questionnaire was utilized to collect demographic information as well as the number of courses and seminars attended or completed in preparation for online teaching.

The participants were 32 third year preservice secondary mathematics teachers enrolled in Technology for Teaching and Learning 1 at University of Science and Technology of Southern Philippines, and third year preservice secondary mathematics teachers of Xavier University enrolled in Principles and Strategies of Teaching Mathematics chosen by purposive sampling design. Female students comprised 78.1% of the respondents. The age of the respondents ranged from 19 to 23 years old where the majority (81.2%) are 21 to 22 years old.

Means and standard deviations were calculated to describe the respondents' self-efficacy using descriptive statistics. A paired t-test was conducted to assess if there was a significant change in the online self-efficacy scores

of preservice teachers before and after the authentic learning activities in the domains of student engagement, instructional strategies, classroom management and computer skills. Kruskal-Wallis H test was used to test differences in online teaching self-efficacy scores across groups in terms number of courses taught online and number of seminars on online teaching attended.

5. Results and Discussion

The findings of this study have intriguing ramifications for programs in teacher preparation. The data and analysis have been arranged in a manner that will most effectively address the research objectives that served as the design inspiration for this project.

Mean subscale MESEOT scores for each respondent were calculated in the domains of student engagement, instructional strategies, classroom management, and computer skills. Table 1 displays the results of descriptive analyses.

Table 1. Pre-test and Post-test Online Self-Efficacy Ratings

Domain to Online Teaching Self-Efficacy	Pretest		Posttest	
	Mean	SD	Mean	SD
Student Engagement	7.63	1.46	8.58	1.14
Instructional Strategies	7.56	1.60	8.40	1.15
Classroom Management	7.53	1.44	8.47	1.12
Computer Skills	7.94	1.39	8.53	1.20

Legend: no confidence (0), very little confidence (1-3), some confidence (4-6), a great deal of confidence (7-9), and Complete confidence (10).

Teachers' efficacy in classroom management had the lowest mean score (mean = 7.53, SD = 1.44) and their efficacy in computer skills had the highest mean score (mean = 7.94, SD = 1.39) prior to the administration of the authentic learning activities. The teacher's self-efficacy in instructional strategies has the lowest mean score (mean =8.40 ,sd = 1.15) after the completion of the authentic learning activities for online teaching, while the teacher's self-efficacy in student engagement has the greatest mean score (mean= 8.58, sd = 1.14).

Examination of this table showed that the mean post-test self-efficacy score of the students is higher than the mean pretest self-efficacy scores in the domains of student engagement, instructional strategies, and classroom management and computer skills. In this context, it can be said that the authentic learning activities affected the' self-efficacy levels positively. It is also noticeable that the standard deviation in the self-efficacy scores also decreases after the conduct authentic learning activities. Based on these results, the authentic learning activities about online teaching supported the increase in student's self-efficacy for online teaching.

In order to examine the impact of authentic learning activities on preservice teachers' online teaching self-efficacy, comparisons were made using repeated measures t-test on self-efficacy scores. This test was used to determine if there is a significant difference between the self-efficacy scores for online teaching prior to and following the implementation of authentic learning activities in the domains of student engagement, instructional strategies, classroom management, and computer skills. Table 2 provides a summary of the self-efficacy scores for online teaching across the four areas. The table below demonstrates that online teaching self-efficacy levels are greater after authentic learning activities than they were before. The p-values indicate that the online teaching self-efficacy in the four areas has considerably increased following participation in authentic learning activities. It demonstrates that the training has increased the students' self-efficacy for online instruction. The online teaching training had a beneficial effect on the students' sense of self-efficacy in online teaching.

Table 2. Summary of Test of Difference in Online Teaching self-efficacy before and after the Authentic Learning Activities

Variable	Test	Mean	SD	p-value
Student Engagement	Posttest	8.57	1.14	<0.05*
	Pretest	7.55	1.42	
Instructional Strategies	Posttest	8.5	1.11	<0.05*
	Pretest	7.43	1.61	
Classroom Management	Posttest	8.43	1.12	<0.05*
	Pretest	7.46	1.40	
Computer Skills	Posttest	8.52	1.21	<0.05*
	Pretest	7.84	1.36	

*significant at p<0.05.

As the results above indicated, preservice teachers' capacity to design and carry out a real-world learning environment, which could be used to augment a face-to-face course, was increased by the inclusion of authentic learning activities. The importance of authentic learning principles was furthered by allowing preservice teachers to make imaginative choices for the learning resources they would use on their online learning platform, without being constrained by the instructor's criteria. This result concurs with those of [24], who found that when instructors received training on digital platforms, both their capacity to create online education and their self-efficacy beliefs increased. According to additional data, participants' self-efficacy beliefs in online teaching were substantially correlated with their capacities to engage students in the online classroom, their use of computers and other educational technology, and students' technical literacy. In the study [25] did, they investigated students' opinions of their learning experiences in a realistic instructional setting and concluded that students perceived their learning experiences positively, despite initially feeling anxious and confused.

Table 3. Kruskal-Wallis H-test result for number of seminars on online teaching attended

Number of Seminars attended about Online Teaching	*n*	Mean Rank	df	Chi-square	p-value
0	8	12.06			
1 to 2	5	14.8			
3 to 4	3	24.67	5	5.102	0.404
5 to 6	2	13.5			
More than 6	8	19.13			

*significant at p<0.05.

As Chang [26], Robinia [27] discovered that faculty members' sense of teaching efficacy is influenced by both

personal variables and factors in their teaching contexts, the levels of online teaching efficacy as measured by Mathematics Educators Self-Efficacy for Online Teaching (MESEOT) scores were examined in relation to the number of online teaching experiences and the number of seminars on online teaching attended.

A Kruskal-Wallis H test was conducted to explore the differences in the number of seminars on online teaching attended, the groups are group 0: no seminar attended, group 1: has attended 1 to 2 seminars and group 3: has attended 3 to 4 seminars. The findings revealed that neither the number of online courses taught nor the number of seminars on online teaching that were attended did not significantly differ for the three groups. The results are shown in Table 3 and Table 4.

Table 4. Kruskal-Wallis H-test result for number of courses taught online

Number of Courses Taught Online	*n*	Mean Rank	df	X^2	p-value
0	25	16.67			
1 to 2	6	14.33	2	0.82	0.664
3 to 4	1	23.6			

*significant at p<0.05.

It is interesting that the study's findings indicated no association between preservice teachers' confidence in their capacity to teach online and the quantity of online courses they have taught and the quantity of online teaching seminars they have attended, there are no significant differences in their self-efficacy in this area. The findings indicate that having taught online courses and attending seminars on online teaching did not translate into significantly higher efficacy for teaching online. According to [8], future interest in teaching online was found to be a significant predictor of overall self-efficacy, but only in the subscale of online student engagement.

Table 5. Confidence Level in Engaging in Authentic Activities

Authentic Activities	Mean Score	SD
Online Teaching	8.44	0.73
Creating a Website for a Class	8.56	1.24
Writing a Blog	8.67	0.71
Conducting Synchronous Classes	8.56	0.73
Preparing a Presentation for Class	8.78	1.64

In general, the preservice teachers' responses to the "Survey on Perceptions about Online Teaching" revealed their positive learning experiences during the authentic activities as their level of confidence in carrying out online teaching, building a website for a class, writing a blog, holding synchronous classes, and creating presentations for class have a mean greater than 8.4. Table 5 displayed the results. Responses from open-ended questions also support this result.

Furthermore, the peer reviewing exercises were the key means through which collaborative learning was improved. Overall, participants expressed a high appreciation for the criticism they received from their peers. Peer input included details on the visual layout and multimedia integration in addition to helpful recommendations for changes to the materials. The preservice teachers benefited from giving feedback to their peers because it made them feel more authentic in assessing students' work. When asked about their thoughts about the learning activities, it was frequently stated that they had first felt glad, satisfied, and rewarded after completing all of the tasks but had initially been eager, overwhelmed, and anxious.

6. Conclusion and Recommendations

Due to its flexibility and customizability, the educational shift from traditional classroom instruction to an online setting is becoming more and more common in higher education institutions (HEIs) and even in primary and secondary education. However, the delivery of online learning necessitates teacher readiness and preparation. Online education will now be part of the new normal. The following conclusion was made in light of the study's key findings and the indicated research issues: Preservice teachers' online teaching self-efficacy will rise as a result of having the information and skills necessary to create online lessons and activities, which will in turn affect their actions as future instructors. According to [8], teachers who had experience teaching online were more likely to say they were motivated to do so.

However, there are certain limitations to this study. The results and conclusions from this study cannot be generalized because it was only conducted in one specific scenario. More information on the effects of authentic learning design may be revealed by future research in a different context with a larger sample.

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