

Relationship Between Self-Efficacy and Technology-Based Teaching Styles in Mathematics Education Among Pre-Service Teachers in UPSI

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Abstract Self-efficacy is defined as a task-specific belief in a person's potential and ability to master a skill or a task. As the technology is getting sophisticated, teachers are encouraged to apply the technology as teaching aid tool in the class. This research is done to investigate the relationship between the self-efficacy and the technology-based teaching styles of Mathematics pre-service teachers among Sultan Idris University of Education (UPSI) undergraduates. The research design used in this study is correlational study at where 148 AT14 Bachelor of Education (Mathematics) course and AT48 Bachelor of Science (Mathematics) with Education students are the sample. The statistical method used in this study is descriptive statistic which is mean and inferential statistics through Pearson's correlation were used to study the relationship. The findings show that the level of self-efficacy and practice of technology-based teaching of pre-service teachers is significantly high. The results showed that there was a strong positive significant correlation between the self-efficacy and the technology-based teaching styles of those pre-service teachers ($r=0.656$, $p=0.00$, $p<0.05$). In conclusion, this study unequivocally demonstrates that UPSI's pre-service teachers are well prepared to train themselves with higher self-esteem and hence applying technology-based teaching style while teaching Mathematics.

1 Introduction

Mathematics is no doubt a subject that contributes a major credit in the education field in cultivating qualified and competitive human resources who have got creative, critical, computational and logical thinking [1]. Learning Mathematics is a great way to develop your ability to think systematically and methodically while making decisions and solving problems [2]. As the development of advanced technology getting more sophisticated, there are teachers who apply the technology gadgets and applications as their teaching aid tools. The role of teachers in the class is vitally important to not only spoon-feed the knowledge to the students, but to act as facilitators to help them out in exploring the knowledge. All of

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these factors should be taken into consideration before a pre-service teacher impose own teaching style. Prior to the teaching styles, pre-service teachers should have own self-efficacy in their ability and readiness to master all the mathematical topics and to conduct their teaching lessons in a proper and congruous way. It has been demonstrated that math achievement significantly correlates with math self-efficacy [3].

A person's self-efficacy relates to their confidence in their ability to carry out the behaviours required to achieve particular performance goals [4]. Self-efficacy should be implemented in the inner mind of all and sundry regardless doing anything in order to evaluate their own strengths and weaknesses and to cultivate their confidence in completing the task perfectly. According to [5], teacher's self efficacy is a strong predictor of how and what a teacher would act. However, self-efficacy was not a common evaluation done by those teachers in previous generation. Teaching self-efficacy was only being widely introduced in education field since the year of 2020 due to the pandemic COVID-19 [6]. Besides, with the development and invention of the advanced technology, mathematics teachers are expected to explore the integration of information and communication technology (ICT) and integrate it into the combined dynamics of teaching styles in order to enhance the teaching quality [7]. Nevertheless, there are still lots of teachers stucked with the traditional teaching styles and find it difficult to alter their lesson plan even though when their teaching styles are not in keeping with students' needs [8].

Therefore, this research is done in order to investigate the relationship between the self-efficacy and the teaching styles of Mathematics pre-service teachers among Sultan Idris University of Education (UPSI) undergraduates. Multiple studies of this research field have been done. However, there is no study specify the research on the self-efficacy of pre-service teachers in Mathematics education or even the teaching styles of them. The research relating self-efficacy and teaching styles were also mostly conducted overseas, such as United States, Spain and much more other countries, but not Malaysia. The confidence level and the ability of those pre-service teachers are unknown. Research objective is the purpose of the implementation of the research and it states the anticipated knowledge to be generated through the research. The research objectives of this study are to determine the self-efficacy level towards Mathematics teaching among UPSI pre-service teachers, to determine the practice level of the Mathematics technology-based teaching style conducted among UPSI pre-service teachers, and to determine the relationship between self-efficacy and Mathematics technology-based teaching style among UPSI pre-service teachers.

2 RESEARCH QUESTIONS

The research questions that will be investigated in this study are:

Q1: What is the self-efficacy level towards Mathematics teaching among UPSI pre-service teachers?

Q2: What is the practice level of the Mathematics technology-based teaching style conducted among UPSI pre-service teachers?

Q3: What is the relationship between self-efficacy and Mathematics technology-based teaching style among UPSI pre-service teachers?

3 RESEARCH HYPOTHESIS

H₀: There is no relationship between self-efficacy and Mathematics technology-based teaching styles among UPSI pre-service teachers.

H₁: There is a relationship between self-efficacy and Mathematics technology-based teaching styles among UPSI pre-service teachers.

4 LITERATURE REVIEW

Self-efficacy as defined by psychology refers to a person's confidence in their ability to take the actions required to achieve particular objectives [3]. Albert Bandura, a psychologist, was the one who first put out the idea. Bandura contends that having mastery experiences is the best approach to increase self-efficacy [9]. These mastering moments can be characterised as individual triumphs. In the midst of difficulties, achieving challenging tasks boosts confidence and resilience. Since they offer the most verifiable proof that a person has what it takes to achieve, mastery experiences are the most significant source of efficacy understanding. Success fosters a strong sense of self-efficacy. Failures damage it, especially if they happen before a strong sense of efficacy has developed. Previous study shows that, teachers' self-efficacy beliefs play a role in fostering their job satisfaction and commitment in interacting with students to ensure their own well being outcomes and students' achievement [10]. Similar research done on pre-service Mathematics teachers shows that, perceived self-determination of those teachers had been enhanced by doing the self efficacy as they know better on their responsibility, competency, anxiety and autonomy [11].

Technology-based teaching style somehow means that the teachers apply and integrate the advanced technology such as computer and internet in process of teaching. The 21st century has witnessed the fast growth of educational technologies, which led to changes in the educational system. This is because technology can offer a proactive, convenient, and all-encompassing teaching and learning atmosphere [12]. In order to improve the implementation of cutting-edge technology in the teaching and learning processes across the globe, the ministry of education now offers multiple resources as well as instructional programmes. To give teachers the tools they require to strengthen the educational system, a large fund has been allocated. Despite all the efforts, the teachers in the majority of nations are not making the maximum use of the available technology [13]. On a daily basis, the use of technology replaces traditional approaches to education. Educational technology in the classroom can be implemented in a variety of ways, from simple using tablets in place of printed materials to using sophisticated software to replace the conventional application of a pen [14]. Regardless of how much technology is used in the teaching process, the use of technology in education has taken centre stage in the educational process.

The topics of self-efficacy and technology-based teaching style are frequently done in the research papers separately. However, the relationship between these two variables is seldom being studied. There are only few researches which have mentioned about the indirect relationship between them. According to a research, the study examines the factors that contributed to the changes in online teaching self-efficacy among teachers in China during the COVID-19 school lockout [6]. Overall, the results of the study show that teaching self-efficacy greatly outperformed online education for technological application, which is mostly regulated by enthusiasm burnout. Readiness to use technology in either a conventional or constructive manner was significantly predicted by pre-service teachers' perceptions of their foundational technological skills and capacity to use technology for pedagogy [15]. However, the pre-service teachers' opinions of their sophisticated equipment had no appreciable effects on how they intended to use it. It suggests that preservice teachers are more likely to boost their self-efficacy in the classroom if they have a solid foundation of proficiency in technological pedagogy and content knowledge.

5 METHODOLOGY

5.1 Research Design

In this research, quantitative method is used in order to figure out further and understand better the self-efficacy level and practice of technology-based teaching style of those pre-service teachers. The research design used in this study is correlational study at where the relationship between the self-efficacy and technology-based teaching style of those pre-service Mathematics teachers in UPSI will be determined and measured. One of the advantages of correlational study is to examine to relationship between the variables without manipulating them, which can be helpful when it is impractical or unethical to control the variables.

5.2 Population and Sample

For this correlational study, the population set is focused on all the Mathematics pre-service teachers. The population of this study consisted of AT14 Bachelor of Education (Mathematics) course and AT48 Bachelor of Science (Mathematics) with Education students who have gone through their first teaching training, mainly the Semester 7 students from UPSI in Perak. There are approximately 240 Mathematics major undergraduate students who fulfill the requirement. On average if the total study population was 240 students, then the required study sample size was 148 students [16].

5.3 Sampling Method

The sampling methods used for the correlational study is the simple random sampling for volunteered respondents. To avoid sampling bias from happening, random sampling method is used in order to get the volunteered respondents.

5.4 Instrument

For this correlational study, the research instrument used is questionnaire. The questions are orderly arranged in the questionnaire form in order to make it easy and clear for the respondents to understand the intent of the research better. The questionnaire form prepared consists of three sections. In Part I, the basic profile details of the respondents will be collected, such as gender, course, and semester. Meanwhile, the Part II of the questionnaire form consists of their self-efficacy from the aspects of their confidence level towards their knowledge preparedness, mathematical problem solving ability as well as their teaching ability. The practice of their technology-based teaching style will be measured in Part III from the aspects of their Information and Communication Technology (ICT) knowledge, the appliances they will be using in the class as well as how they apply and implement the technology in their teaching.

In this study, three experts were chosen to validate the instruments before the questionnaire is distributed to the sample in order to prove the evidence with good content validity [17]. The criteria of being the expert chosen must be an expert from Mathematics Department and has more than 10 years of teaching experience in Mathematics or Additional Mathematics subject in order to make them in order to make sure the instrument is relevant and suitable for the topic studied [18]. For quantitative research of correlational study, the measure method to ensure the reliability of the instrument is using the internal consistency measurement which called Cronbach's Alpha. The Cronbach's Alpha (α)

technique is used as the responses do not indicate whether a response is correct or incorrect, pass or fail, but rather the level of agreement to which the respondents agree or disagree with each statement made in the instrument. High Cronbach's alpha values show that participant response values are consistent throughout a set of questions and vice versa. If the Cronbach's alpha value for each instrument's internal scale was greater than 0.7 ($\alpha > 0.7$), the study instrument was believed to have an appropriate level of internal consistency [19].

5.5 Data Analysis

In this correlational study, the IBM Statistical Package for the Social Sciences software version 27 is used to analyse the survey data. To evaluate the self-efficacy level and practice level of technology-based teaching style among UPSI pre-service Mathematics teachers, a descriptive analysis will be done on the first and second research questions. In order to illustrate the self-efficacy of confidence level towards their knowledge preparedness, mathematical problem solving ability as well as their teaching ability of UPSI pre-service teachers; as well as the Information and Communication Technology (ICT) knowledge, the appliances and applications of technology-based teaching style of those UPSI pre-service teachers, descriptive statistical data will be presented using the mean. To determine the relationship between self-efficacy and technology-based teaching style among the pre-service Mathematics teachers in UPSI, correlation analysis using Pearson correlation is employed in this study. Whether the data is presented as intervals or ratios, Pearson correlation analysis is performed to evaluate the relationship between the two variables [20].

6 RESULTS AND DISCUSSION

6.1 Analysis of Respondents by Gender

A total of 148 respondents, 61 (41.2%) male and 87 (58.8%) female, from the AT14 Bachelor of Education (Mathematics) course and the AT48 Bachelor of Science (Mathematics) with Education course participated in this study.

6.2 Analysis of Respondents by Course

Of the respondents, 100 (67.6%) from the AT14 Bachelor of Education (Mathematics) course, and 48 (32.4%) from the AT48 Bachelor of Science (Mathematics) with Education course.

6.3 Analysis of Respondents by Current Semester

Most respondents are currently studying semester 7, which is 130 people (87.8%) while 18 people (12.2%) are currently studying semester 6. This means that all the sample of Mathematics pre-service teachers in UPSI have official experience in teaching secondary Mathematics when having the teaching practice.

6.4 Analysis of Pre-Service Teachers' Self-Efficacy from Knowledge Preparedness, Mathematics Problem Solving Ability, and Mathematics Teaching Ability Aspects

Table 1. Analysis of Pre-Service Teachers' Self-Efficacy from Knowledge Preparedness, Mathematics Problem Solving Ability, and Mathematics Teaching Ability Aspects

Self-Efficacy Aspects	Mean Score	Mean Interpretation
Knowledge Preparedness	3.64	High
Mathematics Problem Solving Ability	3.68	High
Mathematics Teaching Ability	3.64	High
Average Overall Mean Score and Interpretation	3.65	High

Table 1 shows that pre-service teachers have a high mean of 3.65 for knowledge preparedness, Mathematics problem solving ability, and Mathematics teaching ability when it comes to the self-efficacy towards secondary Mathematics education. People who are confident in their capacity to achieve a task put forth a higher and more persistent effort to do so. A study conducted which revealed that educators who possess a higher level of self-efficacy regularly offer their students academic response opportunities, academic compliments, and academic constructive feedback [21]. Teachers who score highly on the efficacy scale in this study are also adept at encouraging student engagement and maintaining order in the classroom.

Findings of the study shows that pre-service teachers have a high mean for knowledge preparedness, Mathematics problem solving ability, and Mathematics teaching ability when it comes to the self-efficacy towards secondary Mathematics education. Out of the three components, the Mathematics problem solving ability component had the highest score. This demonstrated that pre-service teachers are well-versed in solving Mathematics questions and are always ready to help students solving those HOTS questions when being asked impromptly by the students. However, the mean score of knowledge preparedness and Mathematics teaching ability are slightly lower than the Mathematics problem solving ability. This indicates that the pre-service teachers have lower confidence on their knowledge preparedness level and their teaching ability in Mathematics education. This condition happened might due to most of the fresh-graduated Mathematics teachers have their own thinking style in solving Mathematics questions but they find it difficult in explaining to the students their thinking styles inventory [22]. Indirectly, they might be less confident towards their knowledge preparedness and teaching ability as they can't be able to explain the solution in the way they brainstorm it in details to the students.

In order to increase the pre-service teachers' self efficacy towards secondary Mathematics education regarding the aspects of knowledge preparedness, Mathematics problem solving ability, and Mathematics teaching ability, the pre-service teachers may join more education programme and gain the experiences in teaching. Many researchers have focused on the stress and burnout that preservice teachers go through when they complete their program may make changes to their teaching ability first few years in the classroom [23, 24]. Self-doubt, intense emotions, vulnerability, and stress are common characteristics of learning to teach, and they can cause preservice teachers to drop out of programs and early career teachers to quit teaching entirely [25, 26]. Pre-service teachers might discover, for instance, that the kind of teacher they imagined themselves to be when they first entered the field does not match the kind of teacher they end up becoming during their student teaching experience or as they begin their first years of teaching [27, 28].

6.5 Analysis of Pre-Service Teachers' Practice of Technology-Based Teaching Style from ICT Knowledge, Appliances, Application and Implementation Aspects

Table 2. Analysis of Pre-Service Teachers' Practice of Technology-Based Teaching Style from ICT Knowledge, Appliances, Application and Implementation Aspects

Practice of Technology-Based Teaching Style Aspects	Mean Score	Mean Interpretation
ICT Knowledge	3.44	High
Appliances	3.31	High
Application and Implementation	3.34	High
Average Overall Mean Score and Interpretation	3.36	High

Table 2 shows that pre-service teachers have a high mean of 3.36 for ICT knowledge, appliances, as well as application and implementation when it comes to the practice of technology-based teaching style towards secondary Mathematics education. The ICT knowledge component had the highest score out of the three, and the appliances component had the lowest. This shows that the pre-service teachers have got enough knowledge about the usage of technology but they are lack of practice in implementing it into education.

This condition is because the pre-service teachers in this 21st century are well-versed with all those ICT knowledges and they are also used to using those familiar and easy-to-get technology appliances and applications in their daily life [29]. Meanwhile, the appliances component had the lowest mean score among the three aspects as the pre-service teachers might find it difficult to get the technology appliances in schools. Not all schools are well equipped with the facilities as well as the technology gadgets, especially those schools in rural area [30]. Furthermore, the technology appliances such as visualiser, smart whiteboard and smart console are not frequently seen in most of the schools in Malaysia. Thus, the lack of the appliances in schools has limited the practice of technology-based teaching style of pre-service teachers.

For the use of technology in education to be as effective as possible, practice of technology-based teaching style by pre-service teachers was crucial. The modern educational process is no longer limited to the classroom and can take place at any time or place. Since technology is changing so quickly in this century without us realizing it, educators need to be aware of what is going on with it at all times. One obstacle to the use of technology applications in education is the unfavorable attitudes of some educators who are accustomed to implementing the teaching and learning process through the use of antiquated techniques. To enhance the interaction between teachers and students as well as the process of teaching and learning, a high level of technological knowledge was required [31]. It is imperative that pre-service teachers be provided with ample opportunities to enhance their interest in and proficiency with technology learning applications. This should commence with the instruction they receive from their lecturers during their teaching training.

6.6 Analysis of Relationship Between Self-Efficacy And Mathematics Technology-Based Teaching Style Among Upsi Pre-Service Teachers

Table 3. Analysis Between The Self-Efficacy And Mathematics Technology-Based Teaching Styles Among UPSI Pre-Service Teachers

	Self-Efficacy	Technology-Based
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	Teaching Style		
Self-Efficacy	Pearson Correlation	1	.656**
	Sig. (2-tailed)		.000
	N	148	148
Technology-Based Teaching Style	Pearson Correlation	.656**	1
	Sig. (2-tailed)	.000	
	N	148	148

**Correlation is significant at the 0.01 level (2-tailed)

Table 3 shows that there was a high positive significant relationship ($r = 0.656$, $p = 0.00$, $p < 0.05$) between self-efficacy and Mathematics technology-based teaching styles among UPSI pre-service teachers. This means that the self-efficacy had a high positive relationship with the practice of technology-based teaching style, i.e. the higher the self-efficacy score, the higher the practice of technology-based teaching style score. This result means that a pre-service teacher who had high self-efficacy was also likely to tend to practise technology-based teaching style. Therefore, the practice level of a pre-service teacher's technology-based teaching style can be expected through his or her level of self-efficacy. Teachers with pedagogical experience and a strong foundation in teaching may find it simpler to incorporate technology into the classroom [32]. A system's usability can influence people's attitudes toward using it [33]. There was a positive relationship between self-efficacy and Mathematics technology-based teaching styles among UPSI pre-service teachers. So, H_0 was rejected.

7 CONCLUSION

The results of the study demonstrates that when it comes to their self-efficacy regarding secondary mathematics education, pre-service teachers have an average high mean score for knowledge preparedness, Mathematics problems solving ability, Mathematics teaching ability. The Mathematics problem solving ability item received the highest score out of the three items. When it comes to the practice of technology-based teaching style towards secondary mathematics education, Meanwhile, the pre-service teachers have a high mean score for ICT knowledge, appliances, as well as application and implementation when it comes to the practice of technology-based teaching style. The ICT knowledge component had the highest score of the three items. The result of the study also indicates that there was a strong positive correlation between the practice of technology-based teaching style and self-efficacy, meaning that the higher the practice of technology-based teaching style score, the higher the self-efficacy score.

It is necessary to periodically enhance pre-service teachers' self-efficacy and the practice of technology-based teaching style in order to fulfill the MoE's goal of raising the standard of global education. Nonetheless, certain limitations are evident, including inadequate knowledge about technology, lack of the facilities, and slightly low confidence when it comes to applying technology into teaching practice. This study unequivocally demonstrates that UPSI's pre-service teachers are well prepared to train themselves with higher self-esteem and hence applying technology-based teaching style while teaching Mathematics. Furthermore, the effort paid and encouragement given to the pre-service teachers turned into a focus on their confidence in teaching Mathematics using technology gadgets. This unquestionably indicates how crucial are the pre-service teachers'

roles in increasing the self-efficacy level and practice of technology-based teaching style of themselves.

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