

Elementary School Teachers' Conceptions of Teaching Mathematics with Digital Game-based Teaching

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Abstract

This study aimed to investigate the factors accounting for mathematics teaching self-efficacy and to examine the relationships among Taiwanese teachers' mathematics teaching self-efficacy, teaching and learning conceptions, technological-pedagogical content knowledge for the digital learning, and attitudes toward game based learning. A total of 195 math teachers from 23 elementary schools in Taiwan were invited to take part in the study. After ensuring the validity and reliability of each questionnaire, the results indicated that each measure had satisfactory validity and reliability. Furthermore, the results revealed that teaching and learning conceptions, technological pedagogical content knowledge for the digital learning, and attitudes toward game-based learning mediated the relationship between teaching and learning conceptions and mathematics teaching self-efficacy, suggesting that knowledge of and attitudes toward digital game-based learning mediated the positive relationship between constructivist conceptions of teaching and learning and outcome expectancy; however, it mediated the negative correlations between traditional conceptions of teaching and learning and teaching efficacy.

Keywords: self-efficacy, TPA CK, digital game based learning

1. Introduction

With the advance and innovation of technology, Internet based instruction has gained increasing attention among science educators and researchers in the field of educational technology. The demand for education and learning has been transformed from the traditional classroom into digital media pluralism teaching methods. Digital game-based learning has been received a growing attention. The majority of elementary schools in

Taiwan in terms of teaching practice situation are still facing the non-self-discipline expertise. In such case, elementary teachers (especially non-mathematical or scientific expertise in those years) whether to hold enough teaching digital game-based teaching self-belief and even whether the impact on their quality of education that is well worth the researchers' attention. Additionally, a strong sense of teaching efficacy could influence effective teaching and student achievement in the field of education [1]. However, it is probably more difficult to prepare the mathematics course units for elementary school teachers because they are required to be responsible for teaching the majority of subjects, including both their majors and non-majors, thus leading to a lower sense of self-efficacy related to teaching mathematics [2-3]. Therefore, it is likely that a lower degree of self-efficacy may exist when it comes to mathematics teaching in elementary schools. In this regard, exploring the sources of mathematics teaching self-efficacy among elementary teachers demands immediate attention.

Since [4] suggested that the major factors in accounting for self-efficacy are various kinds of personal experiences, teaching and learning conceptions, which are regarded as factors constructed from previous experience, should be taken into account. Furthermore, Researchers have asserted that Internet-based instruction can meet learners' needs for interactive and individualized learning [5-6]. Accordingly, Internet-based instruction is likely to promote effective teaching, which in turn contributes to teacher self-efficacy. Given this, the current study aimed to investigate factors in explaining the sources of self-efficacy in teaching mathematics with digital game-based environment.

2. Method

2.1. Participants

A total of 195 mathematics teachers (62.3% females) were selected from 23 elementary schools in Taiwan. Of these teachers, 8.6% were less than 30 years old, 38.3% were 31-40 years old, 45.8 were 41-50 years old, 4.2% were 51-60 years old, 1.3% were more than 60 years old, and 1.8% did not report their age. Their teaching experience ranged from 1 to 38 years, with an average of approximately 17 years. Also, 39.4% of the participants had a Bachelor's degree, 58.2% had a Master's degree, 1.5% had a Ph. D., and 0.9% did not report their degree. Although this sample could not be viewed as a national sample, the surveyed teachers came from a variety of schools in Taiwan, across different demographic areas and backgrounds, which may be said to be representative in Taiwan.

In this research, a survey with several dimensions to investigate teachers' self-efficacy beliefs toward their mathematical teaching in terms of mathematics teaching self-efficacy, the traditional or constructivist conceptions of

teaching and learning, and technology pedagogical content knowledge toward games was used. In which, The Mathematics Teaching Self-Efficacy (MTSE) scale was revised and translated from the Science Teaching Efficacy Belief Instrument (STEBI) developed by [2]. The Teaching and Learning Conceptions (TLC) Questionnaire was mainly modeled and translated from the scale developed by [7], included two different conceptions of teaching/ learning: Traditional and Constructivist. Furthermore, to streamline and simplify the models, the survey also integrating some items from TPACK-G questionnaire, which was developed by [8], was proposed to explore teacher' technology pedagogical content knowledge toward games.

2.2. Data Analysis

In order to determine the participant teachers, data analyzing with exploratory factor analysis (EFA) was used to reduce the number of items and to ensure the structures of each measure were employed to test the relationships among teaching and learning conceptions, mathematics teaching self-efficacy, and TPCK-G.

3. Results and Discussion

Table 1 Descriptive statistics and correlations

Descriptive statistics	Correlations							
	Mean	SD	1	2	3	4	5	6
TLC								
1. Constructivist	4.11	0.41	1.00					
2. Traditional MTSE	3.86	0.45	0.09	1.00				
3. Teaching efficacy	4.23	0.38	0.28**	-0.20**	1.00			
4. Outcome expectancy TPACK-G	3.6	0.42	0.21**	0.15	0.33*	1.00		
5. TPACK-G	4.02	0.39	0.28**	-0.25**	0.41**	0.31**	1.00	
6. Attitudes	4.18	0.40	0.23**	-0.21**	0.38**	0.22**	0.58**	1.00

Note: TLC, teaching and learning conceptions; MTSE; mathematics teaching self-efficacy, TPACK-G, technology pedagogical content knowledge toward game.

*p < .05.

**p < .01.

Table 1 contains means, standard deviations and correlations for the major variables. As can be seen in Table 1, constructivist conceptions and the two constructs of mathematics teaching self-efficacy were positively correlated ($r = .28$, $p < .01$ for teaching efficacy; $r = .21$, $p < .01$ for outcome expectancy), indicating that teachers with higher agreement with constructivist teaching conceptions displayed stronger teaching efficacy beliefs and outcome expectancy in mathematics teaching. Also, traditional conceptions and teach-

ing efficacy were negatively correlated ($r = -.20$, $p < .01$), indicating that teachers with more traditional teaching conceptions displayed lower teaching efficacy beliefs in mathematics teaching.

4. Conclusions

The educational and testing systems in Taiwan may impede students' creativity and intrinsic motivation to utilize deep approaches to learning mathematics, decreasing their self-efficacy for

learning mathematics. According to the U. S. Department of Education, "Technology is now considered by most educators and parents to be an integral part of providing a high-quality education". While the use of computer-based technologies is becoming increasingly prevalent, students need to be prepared for the technology-driven workplace with practical skills that can be used in today's innovative world.

Teaching and learning are complex phenomena. Traditional teaching and learning models which focus more on memorization and less on higher level thinking skills are now considered inadequate for the needs of the 21st century classroom. Successful mathematics teachers are acknowledged as being those who are equipped with adequate knowledge and who are capable of developing appropriate pedagogical strategies to accomplish teaching based on various levels of student prior knowledge.

Constructivist learning is considered as a dominant paradigm in the field of education. Given the importance of educational technology, many educators today find the constructivist approach in a technology-rich environment to be more feasible and effective [9-10]. Technology has become an important part of inquiry-based learning. Additionally, the tools of technology can contribute to learning environments in support of inquiry-based learning whereby students develop their information-processing and analysis skills through their own learning experience.

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