New Perspectives in Science Education
International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION


The Development of I2CARE Training Model for Pre-service Science Teachers to Enhance their TPACK Understanding

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Abstract

Science teaching integrated with ICT is usually used in science classroom to gain more understanding in the abstract concepts for the students. However, previous studies had found that preservice science teachers had difficulties about integrating ICT in their teaching. The purpose of this study was to develop a training model for pre-service science teachers for enhancing their TPACK. The training workshop program was a 32-hours program and driven by I2CARE model which consisted of 6 steps : Introduction (I) , Comprehension (C) , Challenging & Designing (CD) , Analysis (A) , Reflection (R) and Evaluation (E). The participants of this study were 10 pre-service science teachers. The instruments were open-ended questions , lesson plan - design assessment , written-refletion , and focus group interview. Quantitative data were analyzed by using the percentages, mean and standard deviation and qualitative data were analyzed by using content analysis. Findings showed that pre-service science teachers had more understandings of TPACK. They could choose appropriately ICT with particular science topic (TCK). They could choose appropriately ICT with particular science teaching approach (TPK). Moreover, they could choose appropriately ICT with particular science teaching approach with particular science topic (TPACK).

Key word: TPACK, Integrated with ICT, science classroom, pre-service science teachers

1. Introduction

The integration of ICT in classroom helps students understand more and it also help to enhance the 21st century skills such as students' higher order thinking skills [2]. However, there were difficulties for many teachers how to integrate ICT in their class effectively [3]. In Thailand, teacher students have to study for 5 years, (4 years for coursework and a year for field experience in school). In a year for their field experience, they had to design lesson plans for their teaching practice under the mentoring of their associate teacher. In previous research, there were many problems in pre-service teachers' teaching and also the idea of ICT integration. They lacked of understanding about how to integrate ICT in their teaching [1]. The way to design activity in science classroom, pre-service teachers should design lesson-plans with real-world problems to let students uses critical thinking to solve problem which focuses on data dealing and uses technology to integrate to help the students reach their fullest potential [2],[3],[14]. Therefore, pre-service teachers should know how to integrate ICT in their science classroom. They should understand the Technological, Pedagogical, and Content Knowledge or TPACK , this framework helps teachers to integrate ICT effectively for their instruction design [7],[8]. The design and implementation of workshop or teacher training programs that promote the TPACK concept to round out teacher or pre-service teacher's knowledge [8]. For the above reasons, developing a training model enhance pre-service teachers 'understanding of TPACK is important to help pre-service teachers to have the experience, knowledge and skills to design their instructional teaching with the integration of ICT in science classroom**.**

2. Theoretical framework

TPACK is the idea that technology integration requires teachers to have knowledge of technology,pedagogy, and content as well as knowledge associated with the intersection of 3 domain knowledge [9]. TPACK framework developed from Pedagogical Content knowledge(PCK) that was introduced by Shulman (1986) [10].,described PCK as the most useful from of content represented thought difference analogies that makes it comprehensible for other. However, the considering from an instructional design perspective [12], content-based learning in science teaching objectives should precede any other. Implication, activities that develop teachers' TPACK should be content-based, allowing teachers to learn

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about and how to teach technology in the context of content-specific activities [2],[13]. Effect to the technology that solve difficult concept of student has a direct role to the PCK main components : Knowledge about students' understanding of specific science topics , instructional strategies for teaching science , and assessment in science. So, this paper PCK defined as the knowledge of pre-service teachers to represent their science content that is difficult for learners to understanding consists of knowledge about students' understanding of specific science topics, instructional strategies, and assessment in science. TPACK defined as the knowledge of integration ICT with science teaching and learning through inquiry-learning activity focus difficultly science-content topic for student.

3. Development of I2CARE model for pre-service teachers to enhance TPACK

The development of I2CARE training model developed base on TPACK – Principles, Integration ICT for science classroom principles, constructivist, social-constructive, collaborative learning and design thinking. I2CARE model consisteds of 6 steps:*Introduction (I)* refer to exploring with prior knowledge of text, images or situations and explain what went wrong. Then something went wrong, a topic introduced into the activity , *Comprehension (C)* refer to using of various methods, the example represented concepts of the individual components of TPACK , *Challenging and Designing (CD)* consisted of 2 sub-steps ; *challenged by problem* refer to each group is questioning the barriers to learning science, challenge themselves and others through discussion groups. Let the message or event that can happen in the classroom and then established solutions. *Designing* refer to the design or solution. The error set up the situation, or some limitations are similar to the context of learning in science classroom. They design guidelines or how to fix a problem that has been set up. , Analysis (A) refers to distinguish why a comparison of the solution and participate in group discussions. Conclusion and share it with the group. Find similarities and differences then conclude and find solutions that are acceptable to both the two groups, Reflection (R) refers to a review of knowledge and expression of ideas that gained from the activity with the expression and understanding of their own, and the last one Evaluation (E) refer to monitor and assess their own knowledge through questions or scheduled event.In the training program consisted of 6 units which were likely make participants become to designers for instruction design. The names of units as follows; Unit 1: enhancing CK) , Unit 2 – 3 : enhancing PCK, Unit 4 : enhancing TK + PCK, and Unit 5 – 6 : enhancing TPACK.

4. Methodology

Participants were 10 pre-service science teachers in Year 5 of their study and they were on their teaching practice in field experience in secondary-levelsschool. They were willing to cooperate for the duration of the research. The Durationof trainingprogramis 32 hours.

4.1 The data collection

The instruments were pre-test and post-test; open-ended question, reflective written, their lesson- plans, the classroom observation and interview. Quantitative data were analyzed by using the percentages, mean and standard deviation so that data score of all components TPACK adopted from PRIM PCK Rubric by Gardner & Gess-Newsome (2011) [13]. And qualitative data were coding and content analysis.

5. Results

The results showed that the percentages of all pre-serviceteachers' TPACK Understanding (post-test) increased in allcomponents (PCK , TPK , TCK , and TPACK). This assumption was confirmed in the post training program. The pre-service teachers' TPACK Understanding of all components increased singnificantly following program participation. (seeTable1)

Table 1: All components TPACK mean scores of pre-service teachers

N=10	PCK (36 full scores)		TCK (7 full scores)		TPK (7 full scores)		TPACK (20 full scores)	
	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
$\bar{x}$	16.93	22.47	2.86	4.53	4.23	5.03	10.93	13.96
S.D.	1.85	2.79	0.74	0.39	0.087	0.125	0.71	1.06
t	12.284*		8.987*		8.985*		10.019*	
p	.000		.000		.000		.000	

*p< .01

Table 2 :Differences of percentile all components TPACK

N=10	TPACK							
	PCK (36 full scores)		TCK (7 full scores)		TPK (7 full scores)		TPACK (20 fullscores)	
	pretest	posttest	pretest	posttest	pretest	posttest	pretest	posttest
$\bar{x}$	16.93	22.47	2.87	4.53	4.23	5.03	10.94	13.96
S.D.	1.85	2.79	0.74	0.39	0.087	0.125	0.71	1.06
%	47.03	62.42	41.00	64.71	60.43	71.86	54.70	69.8
D	15.39		23.71		11.43		14.80	

D = The difference of percentile scores between pretest-posttest

From the table 2 showed TCK (23.71) had the most of the difference of percentile mean scores between pretest-posttest , followed PCK (15.39) , TPACK (14.80) , and TPK. Moreover, the average scores of all pre-service teachers' TPACK understanding reached more than 60% in all components.
From interview , the pre-service teachers showed their TPACK understandings as follows ;
In TPACK , the preservice teachers considered that technology , teaching strategy , and science content should choose appropriately among them. As the interview data from PS1 said that;
"I taught about weather forecasts. As I analysed the contents which were about air pressure and storm movements, they were quite difficult for students to understand. Consequently, I designed the lesson by making a situation that students were going to the beach. Then they heard the weather forecast that the storm was coming so they should make a plan whether to go to the beach or cancel the plan. I provided weather maps by using the information from the Meteorological Department of Thailand website. My student had to analyse and find answers by themselves. They could learn on their owns from the provided ICT media." (PS1**)**

6. Discussion and Conclusion

The per-service teachers' TPACK understanding increased. It may be cause by the I2CARE trainning model that they atended with 4 reasons. First, this training model let pre-service teachers apply knowledge in their real classroom context and other similar contexts. According to West , & Graham (2007) [14] , they found that when the context in the acitities was similar with the pre-service teachers' teaching context and it would be easy for them to apply. Secondly, the training model let them to identifying similarities and differences of many example situations and each of issue in classroom. Similarly, identification of strength and weaknesses is likely to raise science teachers' awareeness of their own teaching methods and roles in the classroom and to result in theire reinforcing the constructivist approach while integrating ICT [15].Thirdly, this training model gave the pre-service teachers to design the lesson collaborately with peers in their group who familiar for share comments together. The comments emerged by peers during practice activities made them aware of many concepts of teaching. According to Jang (2008) [16] found that peer coaching enhanced both the teachers' TPACK and technology integration skills and applying technology more easily if they work together instead of alone. And the last one, in the training model, the trainer demonstrated how to teach according to TPACK integration to enhance the participants' understanding. So, the demonstration promoted pre-service teachers' TPACK understanding according to Alsofyani , & et.al.(2012)[17] ,they found that the use of presentations , demonstrations , practice and feedback was a successful training strategy for TPACK development. The I2CARE training model can be use to provide the initial experience and opportunity for pre-service teachers to understand how to integrate ICT into science teaching. Moreover, to enhance their TPACK development the pre-service teachers have to gain more TPACK 's understanding from their future teaching in their real classroom**.**

*This paper is a part of the Ed.D. dissertation, The Development of Professional Development Model for Teachers to Enhance Technological Pedagogical and Content Knowledge for Preservice Science Teachers, of the first author

References

[1]. Bingimals,K.A.(2009). Barriers to the successful integration of ICT in teaching and learning environments : A review of the literature. Eurasia journal of mathematics, science and teachnology education.5(3). pp. 235-245
[2]. Polly,D. (2011). Developing students' Higher-Order Thinking Skills(HOT) throught Technology-Rich Tasks. Educational Technology. pp.20-26

[3]. Zinyahs, M.Z. (2012). ICT Integration in Science Education in The 21st Century : Obstacles and Advantages**.** *Global Voice of Educators. 1(1 June 2012)* : 1-6

[4]. Agyei,D.D. ; &Voogt,J. (2012). Developing technological pedagogical content knowledge in pre-service mathematics teachers through collaborative design. Australasian Journal of Educational Technology. 28 (4).pp.547-564

[7]. Koehler,M.J. ; and Mishra, P. (2008). Introducing TPCK. In Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators. *The AACTE Committee on Innovation and Technology*. pp. 3–29. New York, NY :Routledge.

[8]. Kim, M.C. ;& Freemyer, S. (2011) .Technology Integration in Science Classrooms : Framework, Principles, and Example. *Educational Technology*. 51(1). pp 25-29

[9]. Mishra , P. and Koehler , M. (2006). *Technological Pedagogical ContenKnowledge : A Framework for Teacher knowledge***.** Teachers College Record 108(6) : 1029.

[10]. Shulman, L.S. (1987). Knowledge and teaching : Foundations of the new reform. *Harvard Educational Review.* 57(1). Pp.1-22.

[12]. Gustafson,K. , & Branch,R.M. (2002). Survey of instructional design models. Syracuse,NY:ERIC Clearinghouse.

[13]. Gardner,A.L. ; & Gess-Newsome,J. (2011). A PCK rubric to measure teachers' knowledge of inquiry-based instruction using three data sources. NARST-2011. pp.1-20

[14]. West, R.E. ; & Graham, C.R. (2007). Benefits and challenges of using live modeling to help preservice teachers transfer technology integration principles. Journal of Computing in Teacher Education. 23(4). pp.131-141

[15]. Barak,M. ; Nissim,Y. ; & Ben-Zvi,D. (2011). Aptness between teaching roles and teaching strategies in ICT-Integrated science lessons*. Interdisciplinary Journal of E-Learning and Learning Objects. IJELLO special series of Chais Conference 2011 best papers. 7,*1-18Chen,C.H. (2008). Why do teachers not practice what they believe regarding technology integration ?. *The Journal of Educational Research, 102(1), 65-75*

[16]. Jang, S.J. (2008). Innovations in science teacher education : Effects of integrating technology and team-teaching strategies. Computers and Education. 51(2). pp.646-659

[17]. Alsofyani, M.M. ; & et al. (2012). A preliminary evaluation of short blended online training workshop for TPACK development using technology acceptance model. The Turkish online journal of educational technology.11. pp.20-32