

WCES 2012

Developing pedagogical content knowledge in preservice science teachers through microteaching lesson study

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Abstract

The focal point of this study is to investigate the development of pedagogical content knowledge through focusing on the problems that preservice science teachers run through in “Heat and Temperature” subject of the science course curriculum. One of the qualitative research designs, case study has been benefited in this study. The members of the study group have been chosen from preservice science teachers of the education faculty through deviant case sampling which is one of the purposive methods. The pedagogical developments of the teacher candidates are to be evaluated by recording microteaching practices in “Heat and Temperature” subject within “Special Teaching Methods- II” course. While analyzing data, frequency and percentage values which are two of the descriptive statistics have been benefited. According to the results, it is seen that microteaching practices contribute a lot to the pedagogical content knowledge of preservice science teachers the content knowledge of whom are high in terms of teaching a concept or principle and the content knowledge of whom are high and low in terms of ending and evaluation the course.

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Keywords: Pedagogical Content Knowledge , Micro-Teaching, Heat and Temperature

1. Introduction

When the studies carried out to explore the qualifications of the teachers are taken into account, it is seen that researchers were only interested in subject content knowledge and pedagogical knowledge about teacher candidates and did not focus on how subject content knowledge were transferred in classroom environment (Shulman, 1986). Pedagogical knowledge took second place in terms of importance when the qualification of a teacher is taken into consideration and many researchers often focused on content knowledge in their studies since they thought “someone cannot teach anything without knowing something himself” (Ball, 1988). According to Shulman (1986), it is a “lost paradigm” that a number of researchers focused upon content knowledge in their studies about teacher knowledge, and he derived “Pedagogical Content Knowledge” (PCK) term as a result of this paradigm. Shulman conceptualized PCK term as a synthesis of the content knowledge and pedagogical knowledge. According to Shulman (1986, 1987), PCK could be defined as the most useful presentations, the most powerful comparisons, the best examples and explanations which make a subject in a special field understandable for others and function as a bridge or supplementary between two knowledge categories in which content knowledge and pedagogical

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knowledge coincide. If this knowledge is taken into account within science field, this requires a special knowledge beyond content knowledge which is essential for teacher to teach science.

In many different studies, two points are centred in PCK; 1) PCK is experimental knowledge and skills gained through teaching practice (Baxer ve Lederman, 1999; Gess-Newsome, 1999; Magnusson, Krajacik, & Borko, 1999; Van Driel, Bijaard & Verloop, 2001) 2) PCK is the integrated structure of knowledge, concepts, beliefs and values developed by teachers during teaching practices (Van Driel, Verloop, & De Vos, 1998; Gess-Newsome, 1999; Loughran, Milroy, Berry, Gunstone, & Mulhall, 2001; Loughran, Mulhall, & Berry, 2004). Preservice teachers take courses during teachership practices about the development of PCK (Lee, Brown, Luft, & Roehrig, 2007) that they have in limited or minimum level. These courses are “Teaching Practices” that they have during their teaching practices in elementary schools and “Special Teaching Methods I” in which microteaching practices are carried out. Microteaching practices are carried out either in real class environment or artificial classroom environment known also as laboratory environment.

Microteaching method is benefited in many countries to train teachers. Microteaching prepares preservice teachers both for teaching practices and teachership (Güney & Ersoy, 2010). The attitudes of the preservice teachers are again and again analyzed through microteaching practices, and thus it gives a chance to discuss and find out what the problems are, what causes them and what the solution is (Erökten & Durkan, 2009). In a more general sense, it is a practical method which provides teaching skills as an outcome of which a chance for analysis is created (Güney, 2008).

In that way, microteaching method contributes a lot to preservice teachers in terms of PCK development. It includes some practices and theories about how a subject could be better taught through different strategies, methods and techniques, how this could be made more understandable for students and how this could be developed for better realization of students (Canbazoğlu, 2008). Therefore, “*Pedagogical Content Knowledge is of special interest because it identifies the distinctive bodies of knowledge for teaching*” (Shulman, 1987).

In this study, “Heat and Temperature” subject has been chosen to determine the development of preservice teachers’ PCK levels. Different strategies are benefited to eliminate learning difficulties and misconceptions about Heat and Temperature subject. One of these strategies is microteaching practices (Kuran, 2009). Because, it is seen that teachers practice their skills and knowledge about teaching in a better way in microteaching practices (Kuran, 2009) and thus it enables PCK to be developed (Canbazoğlu, 2008). In this respect, fourth-year students’ microteaching practices about “Special Teaching Methods I” course and “Heat and Temperature” subject has been recorded, their PCK development has been analyzed and their teaching experiences in class have been examined.

2. Method

2.1. Research Model

In this study, one of the qualitative research designs, case study, has been benefited to find out the PCK developments of preservice teachers through microteaching method. According to Merriam (1998), case study is the best tool to gain “definitions and analyses of one unit or one system which is limited to one individual, program or group”.

2.2. Study Group

The members of the study group have been chosen from preservice science teachers of the education faculty through deviant case sampling which is one the purposive methods. According to Kılıç Çakmak, Akgün, Karadeniz & Demirel (2008), it is accepted that deviant sampling example enables researchers to examine variability of the deviant situations and examples about a certain problem. The aim in this method is to view the nature of variability about deviant situations in a more plain sense. In this process, reliability and validity studies have been carried out about heat and temperature subject, 15-item measurement tool which has been prepared through multiple-choice questions has been benefited, and the most and the least successful students in class with 22 students have been included as deviant case samplings. In this way, the developments of the students which have misconceptions in the highest and lowest level have been revealed in an uncomplicated way.

2.3. Data Collection Tools

Microteaching Observation Form developed by Kuzu (1996) has been benefited for the collection of data. This form the reliability and validity studies of which were carried out by Kuzu is a five dimensional form (Introduction to Course Activities, Teaching a Concept and Principle, Practice of the Questioning Technique, Demonstration of the Skills, Ending and Evaluation of the Course). Microteaching Observation Form has been benefited during self, peer and expert assessments by researchers. In the end, “Teaching a Concept and Principle” and “Ending and Evaluation of the Course” dimensions of Microteaching Observation Form have been used.

2.4. Application Process

Microteaching practices within Special Teaching Methods II course have been fulfilled during four weeks. Two teachers’ teaching practices about the subtitles of heat and temperature subject have been recorded. One day later, this video has been watched by teacher candidate’s friends and teacher in classroom environment. After this, Microteaching Observation Form has been filled by teacher candidate’s own, his peers and teacher. Then, a restructuring process about the course has been accomplished through self, peer and teacher assessments within the scope of Microteaching Observation Form. Within the context of this restructuring, the same subject has been again taught one week later by the same person. Again, self, peer and teacher assessments have been applied. Then, the first and the second Microteaching Observation Forms’ results have been compared with each other and the development of teacher’s teaching process has been evaluated.

2.5. Analysis of Data

Descriptive statistics have been benefited for data analysis. At this point, frequency and percentage values of the self, peer and teacher assessments which have been gained quantitatively have been compared.

3. Result and Discussion

Findings concerning self, peer and teacher assessments of the teacher candidates the content knowledge of whom are low and high within the context of Teaching a Concept and Principle as a result of Microteaching Practices I and II are given in Table 1.

Table 1. Independent-Samples t- Test Results about Microteaching Practices of the Teacher Candidates the Content Knowledge of whom are Low and High within the Context of Teaching a Concept and Principle

	Content Knowledge	Assessments	Context	N	Mean	Std. Deviation	t	p
Microteaching Practices (I and II)	High	Teacher Assessment	Teaching a Concept and Principle -I	8	1,750	,707	2,828	.013*
			Teaching a Concept and Principle -II	8	2,750	,707		
		Self Assessment	Teaching a Concept and Principle -I	8	2,625	,517	3,631	.003*
			Teaching a Concept and Principle -II	8	3,750	,707		
		Peer Assessment	Teaching a Concept and Principle -I	8	2,434	,335	1,711	.109
			Teaching a Concept and Principle -II	8	2,871	,640		
	Low	Teacher Assessment	Teaching a Concept and Principle -I	8	1,375	,744	720	.483
			Teaching a Concept and Principle -II	8	1,125	,640		
		Self Assessment	Teaching a Concept and Principle I	8	2,625	,517	-,858	.405
			Teaching a Concept and Principle -II	8	2,875	,640		
		Peer Assessment	Teaching a Concept and Principle -I	8	2,827	,200	,686	.504
			Teaching a Concept and Principle -II	8	2,738	,308		

According to data in Table 1, it is seen that there is a statistically significant difference in terms of teacher ($t=3,631$; $p<.05$) and self assessments ($t=3,631$; $p<.05$) for teacher candidate the content knowledge of whom is high within the context of Teaching A concept and Principle in Microteaching Practices I and II. In other words, according to teacher and self assessments, there is a significant increase in favour of Microteaching Practices II between Microteaching Practices I and II. Besides, it is observed that microteaching practices provide experience for teacher candidates and develop them if microteaching practices are in favour of Microteaching Practices II within the context of Teaching Concept and Principle.

Findings concerning self, peer and teacher assessments of the teacher candidates the content knowledge of whom are low and high within the context of Ending and Evaluation of the Course as a result of Microteaching Practices I and II are given in Table 2.

Table 2. Independent-Samples t- Test Results about Microteaching Practices of the Teacher Candidates the Content Knowledge of whom are Low and High within the Context of Ending and Evaluation of the Course

	Content Knowledge	Assessment	Context	N	Mean	Std. Deviation	t	p
Microteaching Practices (I and II)	High	Teacher Assessment	Ending and Evaluation of the Course -I	8	1,875	,991	1,727	.106
			Ending and Evaluation of the Course -II	8	2,750	1,035		
		Self Assessment	Ending and Evaluation of the Course -I	8	2,750	,462	4,075	.001*
			Ending and Evaluation of the Course -II	8	4,125	,834		
		Peer Assessment	Ending and Evaluation of the Course I	8	2,7555	,920	1,302	.214
			Ending and Evaluation of the Course -II	8	3,247	,544		
	Low	Teacher Assessment	Ending and Evaluation of the Course -I	8	,625	,744	1,637	.124
			Ending and Evaluation of the Course -II	8	1,375	1,060		
		Self Assessment	Ending and Evaluation of the Course I	8	2,500	,534	13,229	.000*
			Ending and Evaluation of the Course -II	8	5,000	,000		
		Peer Assessment	Ending and Evaluation of the Course -I	8	2,565	,278	,267	.793
			Ending and Evaluation of the Course -II	8	2,511	,494		

According to the results in Table 2, it is seen that there is a statistically significant difference in terms of self assessments ($t=4,075$; $p<.05$) of the teacher candidate the content knowledge of whom is high within the context of Ending and Evaluation of the Course in Microteaching Practices I and II. Besides, according to the results in Table 1, it is observed that there is a considerable difference in terms of self assessments of the teacher candidate in Microteaching Practices I and II if we take teacher candidate with low content knowledge within the context of Ending and Evaluation of the Course. In other words, there is a significant increase in favour of Microteaching Practices II between MTP I and II when we focus upon the self assessments of the teacher candidates with low and high content knowledge. Besides, that assessment results are in favour of MTP II within the context of Ending and Evaluation of the Course shows that MTP provide experience for teacher candidates and develop them.

In general, findings concerning correlation coefficients among self, peer and teacher candidates in MTP are given in Table 3.

Table 3. Findings concerning Pearson Correlation Coefficients related with self, peer and teacher assessments in microteaching practices

	Teacher Assessment	Self Assessment	Peer Assessment
Teacher Assessment	r	1	,299(*)
	p		,016
	n	64	,016
Self Assessment	r		1
	p		,128
	n	64	,315
Peer Assessment	r		1
	p		
	n		64

*0.05 level, **0.01 level

According to the result in Table 3, it is seen that there is a statistically significant correlation between teacher and self assessments ($r=.299$; $p<.05$) and teacher and peer assessments ($r=.371$; $p<.001$). In other words, the assessments of the teacher candidates in microteaching practices show that there is consistency among teacher, peer and self assessment points.

4. Conclusion and Suggestions

According to the results in Table 1, there is a considerable difference in terms of teacher and self assessments of the teacher candidates with high content knowledge in MTP I and II within the context of Teaching A Concept and Principle. It is also seen that there is an increase in favour of MTP II between MTP I and II according to teacher and self assessments. Besides, it is considered that it provides experience for teacher candidates when assessments are in favour of MTP II within the context of Teaching a Concept and Principle. According to the results in Table 2, it is observed that there is a significant difference in terms of self assessments of the teacher candidates with high content knowledge in MTP I and II within the context of Ending and Evaluation of the Course. Also, it is viewed that there is a statistically meaningful difference in terms of self assessment of the teacher candidate in MTP I and II if it is taken into consideration from the perspective of teacher candidates the content knowledge of whom are low. In other words, it is seen that the perceptions of the teacher candidates about their self assessments are meaningfully increasing in favour of MTP II between MTP I and II. It is also observed that it provides experience for teacher candidates and develop them in the eyes of teacher candidates if assessment results are in the favour of MTP II within the context of Ending and Evaluation of the Course.

According to a number of studies (Baxer & Lederman, 1999; Gess-Newsome, 1999; Magnusson, Krajacik, & Borko, 1999; Van Driel, Bijaard & Verloop, 2001) it is pointed out that teaching experience is an important factor for the development of pedagogical content knowledge. Pedagogical content knowledge develops along with teaching experience. One of the ways of providing experience for preservice teachers could be microteaching practices with artificial class environments. Microteaching practices carried out by preservice teachers will create an opportunity for them to use their theoretical content knowledge and pedagogical knowledge in classroom environment. In this way, preservice teachers could catch the chance of gaining experience through new synthesis. Pedagogical content knowledge is different from pedagogical knowledge and content knowledge just as a substance obtained as a result of a chemical reactions is a new one different from all substances that reacted in the beginning. To be able to contribute to preservice teachers' developments and new studies;

- It could contribute a lot to the developments of teacher candidates if microteaching practices are carried out within the scope of Special Teaching Techniques II course definitions which are found in the curriculums of education faculties and used in a more influential way.
- Microteaching practices requires physical environment and technical equipments. At this point, schools should be provided with essential support.

- This study includes observation forms concerning microteaching practices.
- A study to be carried out in the near future could be configured through interviews with teacher candidates in qualitative context. Therefore, this occasion could be taken into account from a different point of view.

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