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Development of Preservice Mathematics Teachers' TPACK through Micro Teaching: Teaching the VuStat Program

Yılmaz Mutlu, Semra Polat, Seyfettin Alan

Abstract

The purpose of this study is to examine the effects of micro-teaching practices with the VuStat program on the techno-pedagogical content knowledge of mathematics teacher candidates. Participants of the study consisted of ten mathematics teacher candidates who continued to fourth grade. Teacher candidates were informed the features and use of the VuStat program through sample tasks over 10 lesson hours (two weeks). Teacher candidates' first presentations were recorded and their both presentations were assessed. A ten-item observation form was used in the evaluation of the presentations. The assessment forms were examined taking into account the positive and negative comments. The results have showed that the positive responses about all the prospective teachers showed an increase compared to the first stage. It was seen that the positive response rate increased from 58.6% to 87.3%. In addition, teacher candidates think that technological constraints exist in stage1, while their views on technology in stage2 showed a positive development.

Keywords: Mathematics teacher candidates, TPACK, VuStat, micro teaching.

Introduction

Defining and evaluating effective teaching has been handled in countless ways for many years, and the qualities that a qualified teacher should have are presented in different forms (Yiğit, 2010). But it is not easy to determine exactly what effective teaching means and what a qualified teacher should do (Atkinson & Claxton, 2000; Wragg, 1989). Indeed, while some educators consider an effective teacher to be a person with professional skills, others treat it as someone who constructs and organizes the teaching environment (TTA, 2002). When it is thought that teaching is a profession requiring special knowledge and skills, it is suggested that the teachers should have some skills in creating effective learning environments and doing their professions (Sisman and Acat, 2003). When the nature of education is mentioned, the issue that researchers emphasize is teacher quality (Darling Hammond, Holtzman, Gatlin & Heilig, 2005, Rivkin, Hanushek & Kain, 2005; Seferoğlu, 2004). The existence of a number of studies suggesting that teacher quality influences student achievement positively (Howell, Hunt-Barron, Kaminski & Rachel Sanders, 2018; Domitrovich et al., 2009; Garet et al., 2010; Gowlett et al., 2015; Penuel, Fishman, Yamaguchi, & Gallagher, 2007) led researchers to focus on supporting teachers' professional development (TED, 2009). Similarly, the investigation of the knowledge and skills needed by teachers, and the question of how best to support them at the point of competence ensures that professional development programs (PDP) are organized (Banilower, Heck and Weiss, 2007, Borko and Putnam, 1998).

Professional development is seen as an important part of education and an ongoing wrap-a-process. Guskey (2000), who examines professional development of teachers, defines professional development as "processes and activities aimed at improving the professional knowledge, skills and attitudes of the educators in order to support the development of the students". Attention should be paid to the fact that the professional development programs are organized in such a way as to be sustainable and clear to understand, to involve active learning, and to ensure teachers' collective participation (Desimone, 2009). The NCTM emphasizes that teacher development programs should be organized to include four issues (Doerr, Goldsmith, Lewis, 2010): First, it should build mathematical content knowledge of teachers and how to use this information in practice. Second, professional development programs should support teachers' ability to respond to mathematical considerations of students and to raise awareness at the point of mathematical ideas. Thirdly, the PDP should focus not only on teachers' content and pedagogical knowledge but also on the trends and attitudes towards learning and teaching mathematics. Finally, with the conclusion of formal professional development experiences, the MGP should develop learning communities where teachers can continue their learning process.

Mathematical content and pedagogical knowledge are among the information that teachers want to gain at the point of professional development. Shulman (1986) stated that teachers should have general field knowledge, curriculum knowledge and pedagogical knowledge. According to Shulman, field knowledge is the subject knowledge that a teacher or teacher candidate will teach about the field. This information is far more than the subject matter knowledge and deepens with pedagogical knowledge (Shulman, 1986, 1987). Pedagogical knowledge is about a teacher or teacher candidate's knowledge of teaching approaches and how to teach a subject in the most appropriate way.One of the issues that should be emphasized among the information that teachers want to gain at the point of professional development is the skill of using technology Davis (2003) notes that the use of information and technology in teacher education will contribute to the development of qualified human power needed today. The use of information and communication technologies in teaching is seen as an important element in order to improve student learning and to make a difference to the classroom environment (Getenet, 2017). What is remarkable is the emphasis on knowledge of technology, content knowledge and pedagogical knowledge in teaching. The conceptual framework that integrates knowledge of technology, content knowledge, and pedagogical content was created by Mishro and Koehler (2006) as 'Technological pedagogical content knowledge'. This framework describes the knowledge that teachers need to know in order to use technology effectively in teaching. When mathematics education is considered, it appears that there are technological programs that will provide teachers with facilities in the teaching of many subjects. One of the programs that can be used for statistics and probability is the VuStat program. The VuStat program is software that supports statistics and probability learning in terms of visualization (Akkoç, 2015). The name 'VU' in his name comes from the visual vocabulary of visual meaning. 'STAT' stands for 'statistics' which means statistics. VuStat offers a variety of opportunities and options for teachers at the point of presentation and lecture of statistics and probability. It is used in the teaching of probability and statistics to students at different levels.

Micro Teaching

Microteaching is a teacher training technique developed by a school at Stanford University and was first applied as a diagnostic tool and combinatorial training in Stanford's summer internship program in the summer of 1963 (Allen, 1967 and Huber and Ward, 1969). This technique has been developed for three purposes; The first was to provide practice and preliminary experience in teaching, the second was to use examining the effects of education under controlled conditions as a research tool, and finally to function as an in-service training tool that gained experience to teachers (Allen, 1967). In the majority of current teacher education programs, the use of micro teaching techniques seems to continue (be, 2001, Benton-Kupper, 2001, Amobi, 2005). Micro teaching can be used for a variety of functions ranging from teacher education to teacher employment and in-service training (Brown, 1975; Baytekin, 2004).

Micro teaching is a technique in which a teacher candidate teaches a small section of a subject with a small group of classmates and folklore, and the teaching competences are examined in detail. Beginning to teach to an entire class is one of the techniques that improve teacher education after a part of the lesson is taught in front of a small group. In addition, teaching a whole lesson can be a useful option in teacher education (Gover, Phillips, Walters, 1995, Capel, Leaks, Turner, 1998, Akalin, 2003). In microteaching, candidate teachers have opportunities to develop skills to attract students' attention, ask questions, use and manage time effectively, and deliver the lesson to a conclusion. They acquire the skills of choosing appropriate student activities, using teaching objectives, and overcoming the difficulties encountered during the process (Kilic, 2010). In addition, they observe and evaluate different teaching strategies by observing their presentations (Higgins, Nicholl, 2003; Kilicnicholl, 2010).

Although student presentations are complete in micro teaching in a microclassroom with a limited time period, the subject discussed is not comprehensive (Tan, 2002; Peker, 2009). Lesson presentations take place in 5-10 minutes (Huber and Ward, 1969) or 10-15 minutes (Klinzing and Floden, 1991; Kpanja, 2001). The number of students (prospective teachers) in the class in which the micro teaching technique is applied is also very low. Usually in microteaching the number of students range between 3-6 (Huber and Ward, 1969) or between 10-16 (Klinzing and Floden, 1991) or between 20-30 (Kpanja, 2001). Lesson presentations can be made either for real students or for students who can be kept equivalent to the truth. Teacher candidates are often presented in a classroom setting. Micro teaching takes place in a cycle (Higgins, Nicholl, 2003)

When the related literature is examined,, it is seen that many micro teaching studies have been done in order to support the professional development of teacher candidates (Akkoç, 2012, Akyüz et al., 2014; Kilic, 2010; Peker, 2009,Semerci, 2011; Kuran 2009). it has been determined that micro-teaching in general contributes positively to teacher candidates regarding love of profession (Kuran, 2009; Sevim, 2013), enhancement of

motivation (Bilen, 2014; Görgen, 2003; Gürses et al., 2005; Sevim, 2013), professional experience (Bilen, 2014; Görgen, 2003; Gürses et al., 2005; Karataş & Cengiz, 2016; Kilic, 2010, Külahçı, 1994; Kuran, 2009; Marulcu & Dedetürk, 2014; Sevim, 2013; Şen, 2010; Yigit, 2010), self-esteem (Bilen, 2014; Görgen, 2003; Karataş & Cengiz, 2016; Külahçı, 1994; Kuran, 2009; Marulcu & Dedetürk, 2014; Peker 2009; Sevim, 2013; Şen, 2010), consideration of criticism (Karataş & Cengiz, 2016; Külahçı, 1994; Marulcu & Dedetürk, 2014; Sevim, 2013; Yigit, 2010), development of communication skills (Bilen, 2014; Görgen, 2003; Gürses &, 2005; Karataş & Cengiz, 2016; Kilic, 2010, Külahçı, 1994; Marulcu & Dedetürk, 2014; Sevim, 2013; Şen, 2010; Yigit, 2010), acquisition of teaching knowledge and skills (Bilen, 2014; Gürses et al, 2005; Kilic, 2010, Külahçı, 1994; Marulcu ve Dedetürk, 2014; Peker, 2009; Savaş,2012; Sevim, 2013; Şen, 2010; Yigit, 2010), material use (Gürses et al. , 2005; Karataş & Cengiz, 2016; Kilic, 2010, Peker, 2009; Şen, 2010), classroom management (Bilen, 2014; Görgen, 2003; Karataş &Cengiz, 2016; Kilic, 2010; Külahçı, 1994; Marulcu & Dedetürk, 2014; Peker, 2009; Sevim, 2013; Şen, 2010), use of the board (Marulcu ve Dedetürk, 2014), spotting missing information and skills (Karataş & Cengiz, 2016; Kuran, 2009; Marulcu & Dedetürk, 2014; Peker, 2009; Sevim, 2013; Şen, 2010; Yigit, 2010).

It is asserted that by means of micro teaching practices teacher candidates have been moved away from excessive excitement and worry about making mistakes in teaching (Bilen, 2014; Çakır, 2000; Görgen, 2003; Gürseset al, 2005; Külahçı, 1994; Marulcu & Dedetürk, 2014 Şen, 2010). It has also been observed that the micro-teaching method is effective in reducing the anxiety of teacher candidates on classroom management, and in increasing their belief in classroom management and teaching competence (Arsal, 2014, Deniz 2010). The results of the above-mentioned studies show that the research carried out at the point of increasing the technology-based knowledge of the teacher candidates has important and positive results. In the present study, it was aimed to develop a micro-teaching program for teacher candidates in order to improve their technological pedagogical field knowledge on axis of VuStat program.

Method

The study was designed according to the pre-test post-test semi-experimental design without control group. Teacher candidates' teaching behaviors before they entered the experiment was determined by pretests and at the end of the treatment the teacher candidates were given posttests.

Participants and Procedure

Participants of the study consisted of ten mathematics teacher candidates who continued to the fourth grade. Eight participants were female and two were male. Participants are taught the features and use of the VuStat program through samples over 10 lesson hours (two weeks). During this period, teacher candidates investigated the statistical topics given to them in middle school mathematics textbooks. The topics were about data analysis learning domain for fifth, sixth, seventh and eighth grades. After the presentation of the lecturer on the interacting board using the VuStat program, each teacher candidate made their first presentations following the lesson plan prepared by them.

An observation form was used for the assessment of teacher candidates' presentations by their six peers. The observation forms were filled during the presentation of their friends. The first presentation of participants was recorded. All the assessment made by his/her peers were compiled and sent to the teacher candidate who had given a presentation. Teacher candidates were asked to review their first presentations in the light of the evaluations made. Participants modified their lesson plans based on the feedback from their peers and the instructor. The second stage presentations and evaluations were held two weeks later.

Data Collection

Participants' presentations were observed. An observation form consisting of ten questions was used as a data collection tool. Data collection was carried out in two stages, after the first and second presentations. The questions on the observation form are below:

1- Does your friend who taught the lesson seem proficient in using the software? (Using menus and the buttons)
2- Could your friend use multiple representations when using VuStat?
3- Were the connections between representations established in a way that a student could understand?

4- Do you think your friend taught the lesson by taking into account the student's difficulties when the concept was taught? Did your friend benefit from technology effectively in this respect?
5- Were the methods and strategies chosen appropriate for technology use?
6- How did the program affect the methods and strategies that your friend had chosen?
7- Did your friend benefit from the program for evaluation?
8- Were there any other evaluation methods or tools that you should have used?
9- Was your friend who was lecturing with technology use successful in classroom management?
10- What kind of advantages and disadvantages did the program your friend used bring to the classroom?

Data Analysis

The assessments made by the teacher candidates were examined taking the positive and negative comments into account. The frequencies of positive and negative comments in the evaluations made in the first and second stages were calculated. In addition, the percentage of the change that occurred between the two stages was also determined and the explanations depicting the performances of prospective teachers in both stages were explained.

Results

In this part of the study, the results of the ten questions directed to prospective teachers were included. In line with the aim of the study, the teacher candidates were asked to answer ten questions about other teacher candidates. The answers given by the teacher candidates to the questions were examined and the comments made were classified as positive-negative.

Firstly, the teacher candidates were asked, "Does your friend who taught the lesson seem proficient in using the software? (using menus and the buttons)". The answers to this question are classified in Table 1.

Table 1. Answers to the first question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	2	4	6	0	**66.7**
PT2	2	4	6	0	**66.7**
PT3	1	5	5	1	**66.7**
PT4	4	2	4	2	**0.0**
PT5	5	1	6	0	**16.7**
PT6	2	4	4	2	**33.3**
PT7	4	2	3	3	**-16.7**
PT8	6	0	6	0	**0.0**
PT9	2	4	3	3	**16.7**
PT10	1	5	5	1	**66.7**
SOC	**29**	**31**	**48**	**12**	**31.7**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

When the Table 1 is examined, it is seen that prospective teachers show improvement in using software between the first stage and the second stage. In the first stage, the number of negative comments made to prospective teachers is more than the number of positive responses. At the end of the second phase, the number of positive responses increased by 31.7% compared to the first stage. Almost all of the teacher candidates have a positive change. Only the number of positive comments remained the same in the two teacher candidates and a decrease in the number of positive comments in one teacher candidate. For PT3 the following comments were made in the first and second stage.

Stage1: He had difficulty in using the software. He was not dominant at all.
Stage2: Yes, he did, he used the software well. Used the buttons in the program effectively.

The second question concerns the representations used by the prospective teachers. The prospective teachers were asked, "Could your friend use multiple representations when using VuStat? Could it be possible to include other representations?" question. The answers to the second question were given in Table 2.

Table 2. Answers to the second question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	4	2	5	1	16.7
PT2	6	0	6	0	0.0
PT3	3	3	6	0	50.0
PT4	5	1	6	0	16.7
PT5	6	0	6	0	0.0
PT6	3	3	5	1	33.3
PT7	4	2	5	1	16.7
PT8	6	0	6	0	0.0
PT9	5	1	6	0	16.7
PT10	6	0	5	1	-16.7
SOC	**48**	**12**	**56**	**4**	**13.3**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

Teacher candidates have benefited from technology for multiple representations in the first stage. The number of positive comments made in both stages is more than negative comments. Nevertheless, positive responses with the second stage increase 13.3%. Only the positive comments of a teacher candidate have reduced and the number of positive comments in the three teacher candidates remained the same.

The third question is about whether technology was used appropriately at the student level. The question, "Were the connections between representations established in a way that a student could understand?" was asked to teacher candidates. The answers to the third question were given in Table 3.

Table 3. Answers to the third question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	0	6	6	0	100.0
PT2	4	2	6	0	33.3
PT3	3	3	5	1	33.3
PT4	3	3	5	1	33.3
PT5	5	1	6	0	16.7
PT6	3	3	5	1	33.3
PT7	5	1	5	1	0.0
PT8	5	1	6	0	16.7
PT9	2	4	2	4	0.0
PT10	1	5	6	0	83.3
SOC	**31**	**29**	**52**	**8**	**%35**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

When the table is examined, it can be seen that the teacher candidates cannot use the technology in the first stage as the students can understand. Negative comments in teacher candidates' answers are almost equal to positive comments. In the second stage, it can be said that the teacher candidates use the technology in a way that the students can understand. There was an increase of 35% on average in the second stage. There was no decrease for any teacher candidates; the positive response rate remained constant for the two teacher candidates. The following comments have been made about PT1.

Stage1: He knew the subject but he could not get the connections that the students would understand because he had difficulties in using the technology.
Stage2: The graphics were set up on the board in an easy and understandable way.

The fourth question concerns whether or not the teacher candidate takes into account student difficulties. Teacher candidates "Do you think your friend taught the lesson by taking into account the student's difficulties when the concept was taught? Did your friend benefit from technology effectively in this respect?" was asked. The answers to the fourth question were given in Table 4.

Table 4. Answers to the fourth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	0	6	4	2	66.7
PT2	3	3	6	0	50.0
PT3	2	4	4	2	33.3
PT4	1	5	4	2	50.0
PT5	3	3	6	0	50.0
PT6	2	4	3	3	16.7
PT7	2	4	4	2	33.3
PT8	2	4	6	0	66.7
PT9	0	6	0	6	0.0
PT10	1	5	5	1	66.7
SOC	**16**	**44**	**42**	**18**	**%43**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

When looking at the Table 4, it can be said that the teacher candidates did not consider the student difficulties in the first stage. In the first stage, there are no candidates among the prospective teachers who have more positive comments than negative ones. In the second stage, there is an increase in the positive responses of almost all prospective teachers. On average, there is a high increase of 43%. Only one teacher candidate' positive comments have not increased. There is not any teacher candidate whose positive comments decreased. The following comments were made for PT5.

Stage 1: *No, he did not take into account students' difficulties.*
Stage 2: *Yes, our friend took the difficulties into account.*

The fifth question concerns teaching methods and strategies. Teacher candidates were asked "Were the methods and strategies chosen appropriate for technology use?" The answers to the fifth question were given in Table 5.

Table 5. Answers to the fifth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**PAC**
PT1	5	1	6	0	16.7
PT2	6	0	6	0	0.0
PT3	4	2	6	0	33.3
PT4	6	0	6	0	0.0
PT5	6	0	6	0	0.0
PT6	4	2	5	1	16.7
PT7	6	0	6	0	0.0
PT8	5	1	6	0	16.7
PT9	4	2	4	2	0.0
PT10	3	3	5	1	33.3
SOC	**49**	**11**	**56**	**4**	**%12**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

When the Table 5 is examined, it is seen that the teacher candidates pay attention to the teaching methods and strategies from the beginning of the study. Comments on teacher candidates are generally positive in both the first and second stages. However, there is a 12% increase in the second stage compared to the first stage. While the positive responses of any teacher candidate did not decrease, the number of positive comments of the four teacher candidates remained the same. The following comments were made about PT3.

Stage 1: He made the classic lecture. Tried to support the lesson with technology but he could not use it.
Stage 2: Usage of a narrative method and question-answer technique

In the sixth question, teacher candidates were asked. How did the program affect the methods and strategies that your friend had chosen? The answers to the sixth question were given in Table 6.

Table 6. Answers to the sixth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	3	3	6	0	50.0
PT2	5	1	6	0	16.7
PT3	2	4	4	2	33.3
PT4	6	0	6	0	0.0
PT5	6	0	6	0	0.0
PT6	5	1	5	1	0.0
PT7	6	0	6	0	0.0
PT8	6	0	6	0	0.0
PT9	2	4	4	2	33.3
PT10	3	3	5	1	33.3
SOC	**44**	**16**	**54**	**6**	**%17**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

Technology has influenced the methods and technologies of teacher candidates positively. The number of positive responses in both the first stage and the second stage is rather high. Looking at all the data, there is a 17% increase in positive responses. The following comments have been made for PT1.

Stage 1: The technology used was adversely affected because it was not possible to fully utilize the technology.
Stage2: positively affected

The seventh question is related to the evaluation methods of the prospective teachers. To the prospective teachers were asked "Did your friend benefit from the program for evaluation?" question. The answers to the seventh question were given in Table 7.

Table 7. Answers to the seventh question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	4	2	5	1	16.7
PT2	4	2	6	0	33.3
PT3	3	3	5	1	33.3
PT4	4	2	4	2	0.0
PT5	3	3	6	0	50.0
PT6	5	1	5	1	0.0
PT7	4	2	6	0	33.3
PT8	5	1	6	0	16.7
PT9	2	4	4	2	33.3
PT10	4	2	5	1	16.7
SOC	**38**	**22**	**52**	**8**	**%23**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

It can be said that teacher candidates have experienced difficulties in the evaluation methods in the first stage. In the second stage, positive comments were mostly given to teacher candidates. According to the first stage, there is a 23% increase in positive responses. The following comments were made for PT5.

Stage 1: Our friend did not ask many questions while teaching. She could not evaluate the student.
Stage2: She used question-answer technique for evaluation.

In the eighth question, teacher candidates were asked "Were there any other evaluation methods or tools that you should have used?" question. The answers to the eighth question were given in Table 8.

Teacher candidates did not benefit from technology in the first stage. At the end of the first stage, the negative responses are more over than the positive ones. At the end of the second stage, there is an increase in the positive responses of almost all of the teacher candidates. Generally speaking, there is a high increase of 43% in favorable responses. The following comments have been made for PT1.

Stage 1: It was not enough. It should be developed.
Stage 2: No, it was not difficult to use the program. It can even be said that it uses effectively!

Table 8. Answers to the eighth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	2	4	3	3	16.7
PT2	4	2	6	0	33.3
PT3	2	4	6	0	66.7
PT4	6	0	6	0	0.0
PT5	3	3	6	0	50.0
PT6	2	4	4	2	33.3
PT7	2	4	6	0	66.7
PT8	2	4	6	0	66.7
PT9	0	6	1	5	16.7
PT10	1	5	6	0	83.3
SOC	**25**	**35**	**50**	**10**	**%42**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

The ninth question concerns classroom management of prospective teachers. To the prospective teachers were asked, "Was your friend who was lecturing with technology use successful in classroom management?" question. The answers to the ninth question were given in Table 9.

Table 9. Answers to the ninth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	2	4	6	0	66.7
PT2	5	1	6	0	16.7
PT3	2	4	6	0	66.7
PT4	6	0	6	0	0.0
PT5	4	2	6	0	33.3
PT6	3	3	5	1	33.3
PT7	6	0	6	0	0.0
PT8	5	1	6	0	16.7
PT9	3	3	5	1	33.3
PT10	3	3	6	0	50.0
SOC	**39**	**21**	**58**	**2**	**%32**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

Teacher candidates for classroom management can be said to be good at both stages. However, it is striking that only two of the comments made at the end of the second stage is negative. There are no candidate teachers with a decline in their positive comments. Generally speaking, there is a 32% increase in positive comments. The following comments have been made for PT6.

Stage 1: Yeah, it's hard on classroom management.
Stage 2: He was good in classroom management

The last question is about the limitations and opportunities that technology brings. To teacher candidates were asked, "What kind of advantages and disadvantages did the program your friend used bring to the classroom?" question. The answers to the tenth question were given in Table 10.

Teacher candidates think that technology gives different possibilities in lecturing. Almost all of the comments made at the end of the second phase are positive comments. Among the comments made, only four comments are negative. Overall, at the end of the second stage, there was a 38% increase in positive comments. The following comments have been made for PT4.

Stage 1: Technology has brought restrictions to our friend instead of benefit. Because he could not use the program and it was a waste of time. The lesson would have ended earlier if the lesson was drawn on the blackboard.
Stage 2: I think it did not bring any restriction, it solved more questions, helped students solve graphics on the board

Table 10. Answers to the tenth question

	Stage 1		**Stage 2**		
PT	**PC**	**NC**	**PC**	**NC**	**AC**
PT1	2	4	6	0	66.7
PT2	3	3	6	0	50.0
PT3	1	5	6	0	83.3
PT4	6	0	6	0	0.0
PT5	4	2	6	0	33.3
PT6	1	5	5	1	66.7
PT7	6	0	6	0	0.0
PT8	6	0	6	0	0.0
PT9	1	5	3	3	33.3
PT10	3	3	6	0	50.0
SOC	**33**	**27**	**56**	**4**	**%38**

PT: Prospective teachers, PC: Positive comment, NC: Negative comment, SOC: Sum of Comments AC: Amount of Change

In general, the number of positive responses for all questions has increased in the second stage compared to the first stage. The biggest increase is 43% for "Do you think your friend taught the lesson by taking into account the student's difficulties when the concept was taught? Did your friend benefit from technology effectively in this respect?" question. It is understood that prospective teachers are not able to use the technology in the first stage in accordance with the grade level. But at the end of the second stage, it can be said that they have developed in this field. Additionally at the end of the second stage, it can be said that the most successful feature of the teacher candidates is their classroom management in a technology-supported educational environment. In the second stage, only two negative comments have been recorded at the end of the second stage, in terms of classroom management issue in micro teaching with the VuStat program.

Conclusion

The present study aims to examine the effects of micro-teaching with the VuStat program on the techno-pedagogical content knowledge of mathematics teacher candidates. Results indicate that there is an increase in the positive responses of all of the prospective teachers compared to the first stage and this increase rate is from 58.6% to 87.3%. Average amount increase is 28.8%. Micro teaching improves the use (Coakley et al , 2017; Gürses et al., 2005; Göçer, 2016; Marulcu & Dedetürk, 2014; Oren, 2017; Yigit, 2010) and knowledge of technology of prospective teachers (Akyüz et al., 2014; Babacan & Ören, 2017; Gürses et al., 2005; Marulcu & Dedetürk, 2014).

In addition, teacher candidates think that technological constraints exist in stage1, while their views on technology in stage2 showed a positive development. In the first stage of the interpretations made, they say it was difficult for the teacher candidate to use the program in the class, but in the second stage this idea was not expressed. Kuran (2009) determined that teacher candidates were more successful than the first application in the second micro-teaching practice. Micro-teaching has increased the knowledge of prospective teachers at the point of choosing technological tools for course presentation and smart board use (Babacan & Ören, 2017). It has also been found that microteaching contributes positively to the TPAB self-esteem in the use of smartboards of prospective teachers (Akyüz et al., 2014).

At stage 1, the view that prospective teachers experience difficulties in classroom management is prevailing, and at the end of stage 2, prospective teachers have adopted the view that classroom management is increasing in a technology-supported education. It is determined that test performances of teacher candidates in the subjects such as course planning, subject knowledge, teaching process, classroom management, communication and evaluation increased statistically after micro-teaching (Kilic, 2010).

Recommendations

The study results and other studies in the area support that micro teaching technique is an effective method for teachers' development of TPAB. Furthermore, the study shows that the VuStat program is an effective program in statistics teaching. It is suggested that studies should be carried out in order to examine the effect of different statistical topics in different teaching stages of the program.

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