



Examination of Pre-service Teachers' Opinions on Designing Technology-Based Courses Activities

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ABSTRACT

In the 21st century, changing and renewing technologies take place in education as well as in every aspect of our lives. As a requirement of this, teachers must be a qualified person that can respond to today's needs. Teachers need to know not only the content knowledge but also the pedagogical and technological knowledge related to their profession. Integrating technologies into learning and teaching environments is a challenging task for many teachers so it is very important for pre-service teachers to be equipped with the necessary qualifications before starting their professional life. The purpose of this research is to reveal the pre-service teachers' opinions about the importance and necessity of technology with pedagogical and content knowledge while designing their pre-professional courses. In accordance with the purpose of the research thirty-nine pre-service biology teachers who are affiliated to pedagogical formation certificate program were participated. The research is conducted with case study design. The data were collected via semi-structured form and were submitted to do content analysis through ATLAS.ti program. All participants designed their presentations with a proper teaching methods and instructional technology. As a result of the research; visual materials, smart board, computer, animations, internet, video, projection, Lab-Quest, educational software and microscope were used as an instructional technology in pre-service teacher's courses. They also stated mostly that providing a better understanding of the subject matter, ensuring permanent learning by students, concretizing abstract concepts via visualization by using these technologies. After their presentations some of the participants defined some difficulties while they were presenting the lesson. These difficulties were categorized related to the use of the technologies, personal problems, time-related problems and physical environment problems. At the end of the research, the opinions about considering points of the redesigned their course. As a result of the research, it is understood that given opportunity to the pre-service teachers could make them to raise their awareness in terms of their professional development.

Keywords: Pre-service teachers, Teaching, Instructional technology

INTRODUCTION

In the new century, changing and renewing technologies take place in education as well as in every aspect of our lives. Students who meet technology at an earlier age, want to take part in a technology-supported teaching process. The education system of the countries has also changed on the active use of technology in courses. In this context, it is one of the extremely critical and important elements required by the era that teachers know, use and integrate technology into their lessons and undergo an appropriate technological education in order to respond to the needs of the students. Teachers must be a qualified person that can respond to today's needs and to know about content knowledge, pedagogical knowledge and technological knowledge about their professions.

Shulman (1986) stated a new concept, pedagogical content knowledge (PCK), which is a special combination of content and pedagogy that form a unique knowledge base for teaching specific disciplines. In general, in accordance with the characteristics of the students in the teaching process; having features such as the application of methods and techniques on learning and assessment, classroom and time management, and planning the lesson true with the curriculum mean that the teacher has pedagogical knowledge. Since the emergence of the concept of PCK with Shulman, many studies on teacher knowledge with different skills have increasingly continued and PCK models have been put forward in different fields (An, Kulm & Wu, 2004; Andyani et al., 2020; Carlsen, 1999; Ernest, 1989; Fennema & Franke, 1992; Gess-Newsome, 2015; Grossman, 1990; Lederman & Zeidler, 1987; Park & Oliver, 2008; Rollnick et al., 2008; Van Driel, Beijaard & Verloop, 200; Wilson & Wineburg, 1988). Teachers with pedagogical knowledge understand how their students construct knowledge, acquire skills, and develop their tendencies towards learning (Magnusson et al., 1999). Pedagogical content knowledge requires teachers to organize the subject matter in detail in accordance with the curriculum, to use various teaching methods while presenting the subject and to have a good command of measurement-evaluation techniques.

The concept of Technological Pedagogical Content Knowledge (TPACK) has emerged, as the importance given to pedagogical content knowledge and its applications have increased, as well as technological tools and materials have begun to take their place in the teaching process actively in recent years. TPACK; It has been defined as an emerging type of knowledge beyond the combination of field, pedagogy and technology (Angeli & Valanides, 2005; Koehler & Mishra, 2005; Margerum-Leys, & Marx, 2002; Mishra & Koehler, 2006, Niess, 2005). With the application of TPACK, teacher should combine technology with pedagogical strategies, integrate it into the process, and organize the effect of technological tools on understanding the subject while teaching a subject related to his field to his students (Graham et al., 2009; Koehler & Mishra, 2009, Niess, 2005).

Integrating technologies into learning and teaching environments is a challenging task for many teachers (Shafer, 2008; So, & Kim, 2009) so it is very important for pre-service teachers to be equipped with the necessary qualifications before starting their professional life. Yılmaz (2007) emphasized the necessity of using technology in education for teachers who will train human power in the issues that society needs.

Science courses are one of the courses that are taught at almost every grade level of our compulsory education system. In general, most students have difficulty in science courses such as biology, physics and chemistry. It is very important for teachers to arouse interest and curiosity in their students, to develop positive attitudes and to increase students' motivation and to ensure their success in science teaching process.

As a point this the required qualifications of pre-service teachers about TPACK in science courses is very important. The main purpose of this research is to reveal the pre-service teachers' opinions about the importance and necessity of technology with pedagogical and content knowledge while designing their pre-professional courses. Answers were sought to the following questions:

1. What are the instructional technologies and purposes of pre-service teachers use during the technology-supported lesson activities they designed within the scope of instructional technologies and material design course?
2. What are the difficulties of pre-service teachers' experiences in the use of instructional technologies within the scope of instructional technologies and material design course?
3. How would you redesign this process if the you were given the opportunity to re-present the topic that presented within the scope of instructional technologies and material design course?

METHODOLOGY

The Model of the Research

In this research, case study design, which is one of the qualitative research methods was used. The most basic feature of the case study is the in-depth investigation of one or more cases (Yıldırım & Şimşek, 2008). Case study defines as a type of research in which information about a current event that continues beyond the researcher's control is obtained by asking what, how and why questions in its real world (Yin, 2014) when the boundaries between the context and the situation are not clear (Gray, 2009; Yin, 2014).

The Participants of the Research

The participants of this research are thirty-nine pre-service biology teachers who are affiliated to pedagogical formation certificate program in one of the universities in Turkey. The research was carried out within the scope of the Instructional Technologies and Material Design course, together with the lecturer and the researcher in 14 weeks. All of the participants were participated in the research on a voluntary basis. The participants forms coded as B1 to B39. Some of their statements were given in accordance with this code.

Data Collection

One of the most frequently used data collection tools in qualitative research based on case studies in the field of social sciences is the interview forms (Yin, 2014; Yıldırım & Şimşek, 2009). Interview is a purposeful activity in which the pre-prepared questions are asked to the desired target person and the interviewee answers the questions (Kuş, 2009). There are three types of interview forms on qualitative researches: structured, semi-structured or unstructured (Punch, 2005).

In this research the data have been collected via semi-structured interview forms. Semi-structured interview form defined as "it is an interview technique that gives the opportunity to ask in-depth questions on a specific subject and to make the situation more descriptive and complete the answers by asking questions again if the answer is incomplete or unclear" (Çepni, 2007). While preparing the questions of semi-structured interview forms; it is important that the questions must be easy-to-understand, purpose-oriented, open-ended questions. In the research the questions were asked to the pre-service teachers after they designed and presented their courses.

Data Analysis

In this research content analysis technique, which is one of the qualitative method techniques has also been used for data analysis. Content analysis is a technique form of interpretation for making inferences by systematically, objectively classifying special characteristics of common statements (Cohen, Manion and Morrison, 2007; Gökçe, 2006). Content analysis reduces and interrogates the answers into summary form through the use of both pre-existing categories and emergent themes in order to generate or test a theory (Cohen et al., 2007).

In this research the data have been submitted to ATLAS.ti package program to analyze. After gathering the same codes of the data, it was arranged by the aspects in a common way and the results were interpreted. As a result of this the data were coded separately by some categories and the results showed in a table that contains the frequency distributions of all codes.

RESULTS

The pre-service teachers who were enrolled in the pedagogical formation certificate program in biology education were asked about the instructional technologies used in the technology-supported lesson activities. The results of the content analysis, the frequency distributions of the codes and the category for instructional technologies used in course activities are shown in Table 1.

Table 1. The frequency distributions of the codes and the category for instructional technologies used in course activities

CATEGORY	CODES	FREQUENCY	TOTAL
INSTRUCTIONAL TECHNOLOGIES	Visual materials	39	192
	Smart Board	30	
	Computer	28	
	Animation	20	
	Internet	20	
	Presentation	18	
	Projection	16	
	Video	12	
	Lab-Quest	4	
	Educational Software	3	
	Microscope	2	

According to Table 1, it is understood that pre-service teachers mostly benefit from visual materials (f=39), smart board (f=30) and computer (f=28) from instructional technologies in the course activities. They were specified that the animations (f=20) and presentations (f=20), the internet (f=20) and power point presentations (f=18) they used for the course content. In addition to these, projection (f=16), videos (f=12), Lab-Quest (f= 4), educational software (f=3), and microscope (f=2) used in experimental activities are other specified teaching methods.

The reasons for preference of pre-service teachers for selecting these instructional technologies were also examined. Their answers were analyzed according to the content analysis and are shown in Table 2. The codes are categorized under 3 categories as effective learning-teaching activities, time and laboratory applications.

Table 2. The frequency distributions of the codes and the categories for the reasons of preference about the instructional technologies used in course activities

CATEGORIES	CODES	Visual materials	Smart Board	Animation	Computer	Projection	Presentation	Internet	Video	Lab-Quest	Educational	Microscope
		EFFECTING LEARNING-TEACHING ACTIVITIES	To provide a better understanding of the subject	16	1	5	7	4	4	3	1	2
To ensure permanent learning	12		7	5	4	1	2		1	2	1	
To make the subject visual	10		5	5	3	3	4	3				1
To make the subject concrete	9		5	4	3	1	3	2	1		2	
To attract students' interest and attention	6		6	5				1	3			
To get rid of monotonous lectures	3		3	3	1	1						
To appeal more sense organs of the students	1		6	4	2	4			1		1	
To enrich the teaching process	2		3	3	1	4	2	1	1		1	
To provide an effective teaching environment	2		3		1	2	2		1			
To make summary of the topic at the end of the lesson			1	1	2				2		1	

TIME	To save time	1	7	3	1			1		1	1
LABORATORY APPLICATION	To turn theory into practice		1							4	2

According to Table 2, among the preference of pre-service teachers for selecting these instructional technologies, the most statements are; to provide a better understanding of the subject (f=16), to ensure permanent learning (f=57), to make the subject visual (f=35), to make the subject visual (f=34), to make the subject concrete (f=30). Other statements were coded as; to attract students' interest and attention (f=21), To appeal more sense organs of the students (f=19), To enrich the teaching process(f=18), To provide an effective teaching environment (f=11) in the effective learning and teaching activities. In time category, the only code is about saving the time (f=15) and the third category, laboratory application, the only code is about turning theory into practice (f=7).

The use of smart boards, animations and computers were preferred to ensure a better understanding of the subject by students, to ensure permanent learning in students, to make the subject as visual, to save time and to attract the attention and interest of the students. The use of projections was preferred to appeal more sense organs of the students, to enrich the teaching process and to provide a providing a better understanding of the subject by the students. In the preference of the internet and the presentations, the expressions were stated as providing a better understanding of the subject by the students, making the subject visual and making the subject concrete. Video was especially preferred to attract students' attention to the lesson and to make a summary of the subject at the end of the lesson. And finally, among the reasons why Lab-Quests and Microscopes are preferred to put the theory into practice, to ensure a better understanding of the subject and to make the subject visually.

Examples of some of the statements given by the pre-service biology teachers' regarding the reasons of preference about the instructional technologies used in course activities are follows:

B7: "I benefited from visual materials, animations, presentations and demonstration activities while I was designing my biology lesson with instructional technology. My purpose in choosing these are to provide a better understanding of the subject with animations and presentations, and to make learning permanent with the designed visual material."

B8: "I used the smart board to embody an abstract subject such as both time saving and inheritance. I also used educational sites for animation and visual materials."

B11: "I actively used the smart board with the smart pen and I also designed the course material by myself in the laboratory applications. At the end of my presentation, I used video to make a summary of my lesson. This application made students to realize a more permanent learning."

B12: "I took an advantage from smart board, projection, computer and visual materials. My purpose in choosing these instructional technologies; to ensure that the information on the subject was learned better with technological tools and to make the subject visually available to everyone."

B13: "I used the teaching technologies such as smart board, video and animation. My aim here was to activate all the senses of the students in learning the subjects and to ensure that the subject is learned by the student and its permanence."

B18: "I designed my course material design and I used it as an instructional technology. I also prefer to use animations, ready-made pictures I got from the internet. My purpose in choosing these was to make students understand better by seeing"

B21: "In my presentation, I benefited from slide presentations, educational software, animation, video demonstration and the model I prepared. The reason I choose them was that I wanted to embody the abstract concepts that I explained to the students and appealed to more sense organs of students."

B33: "I used smart board, projector and LabQuest. I used the LabQuest device efficiently in relation to the subject I described. My aim was to demonstrate the subject I explained in theory experimentally and to make the subject more understandable."

At the end of the presentation of the pre-service teachers were asked whether they had any problems or difficulties while integrating the technology into their course activities, The answers given accordingly are shown in Table 3. According to this, half of the pre-service teachers stated that they had difficulties or troubles, while the other half stated that they did not experience any problems.

Table 3. The frequency distributions of the codes and the categories for integrating technology in to the teaching process

CATEGORY	CODES	FREQUENCY	TOTAL
INTEGRATING TECHNOLOGY INTO THE TEACHING PROCESS	I had some troubles/difficulties	19	39
	I did not have any troubles /difficulties	20	

Some examples of the pre-service biology teachers' that they did not have any troubles or difficulties while integrating the technology into their course activities are follows:

B21: "I did not have any difficulties in incorporating technology into this process"

B22: "It wasn't a problem at all, but I was afraid that it would come out while doing LabQuest"

B28: “No, I haven't had such a problem.”

The question was asked to the pre-service teachers who had troubles or difficulties in integrating instructional technologies into the teaching process about they experienced. Content analysis results based on the answers given are shown in Table 4.

Table 4. The frequency distributions of the codes and the categories for the problems and difficulties while integrating the instructional technologies

CATEGORY	CODES	FREQUENCY	TOTAL
ISSUES RELATING TO THE USE OF TECHNOLOGIES	Transferring the microscope image to the screen	3	9
	Using the LabQuest device	2	
	Animations are usually in foreign languages	2	
	Hard to find educational software	1	
	Lack of animations on the subject	1	
PERSONAL PROBLEMS IN THE USE OF TECHNOLOGIES	Problems in using new technologies	4	7
	Feeling inadequate in using technology	1	
	Feeling inadequate about preparing animation	1	
	Feeling inadequate about preparing simulations	1	
TIME-RELATED PROBLEMS	Lack of time	5	5
PROBLEMS RELATING TO THE PHYSICAL ENVIRONMENT	Power cut of the electricity	2	2

According to Table 4, pre-service teachers' statements about the problems or difficulties while integrating the instructional technologies were categorized into three categories. The first category was defined as the issues relating to the use of technologies. The codes of this category were transferring the microscope image to the screen (f=3), using the LabQuest device (f=2), animations are usually in foreign languages (f=2), hard to find educational software (f=1) and lack of animations on the subject (f=1). The second category, personal problems in the use of technologies, were coded as problems in using new technologies (f=4), feeling inadequate in using technology (f=1), feeling inadequate about preparing animation (f=1), feeling inadequate about preparing simulations (f=1). Lack of time (f=5) code was categorized in time related problems category and power cut of the electricity (f=2) was categorized into the problems relating to the physical environment.

Some examples of the pre-service biology teachers about their troubles and difficulties while integrating the technology into their course activities are follows:

B18: “Yes, I had some difficulties in transferring the microscope image into the screen. But when I solved the problem, the result was really good, I was able to show the microscope image to the whole class at once.”

B26: “I have had some troubles. Due to the unpredictable respiration activity of yeast cells in the LabQuest device, bubbles formed inside the test box and the device failed. We got the test results after we solved the problems. The results were good, but we could not project them onto the smart board. Afterwards, the results were shown on the LabQuest device.”

B38: “The number of animations and simulations made in our own language on the subject that I explained were inadequate. I came across many animations in foreign languages, I think this was a big shortcoming.”

B25: “Unfortunately, I have had a problem. During the presentation, the electricity was cut 3 times in a row. Computer and projector turned off. I reopened them in each time. It caused as a waste of time.”

The pre-service teachers who were enrolled in the pedagogical formation certificate program in biology education were asked about “If you were again design and present this subject matter in your course, what would you consider adding or removing in the process?”. The number of pre-service teachers who stated that they did not want to make any changes in the process is f=9 but the number of those who wanted to make changes in the process was determined as f=30. According to the answers of 30 pre-service teachers' answers, the content analysis was done and the frequency distributions of the codes and the categories are shown in Table 5.

Table 5. The frequency distributions of the codes and the category for considering points of the redesigned course

CATEGORY	CODES	FREQUENCY	TOTAL
UTILIZING INSTRUCTIONAL TECHNOLOGIES	Making more use of animations	22	47
	Making use of more educational materials	15	
	Making more use of videos related to the topic	10	
EFFECTIVE LEARNING ACTIVITIES	Better planning of time	15	44
	Doing activities that will make students more active	10	
	Using more engaging teaching techniques	8	
	Preparing an effective presentation	5	

	Increasing assessment activities	3	
	Making practical applications	2	
	Include up-to-date information	1	

According to Table 5, the issues that the pre-service teachers want to add to their redesigned presentation process are grouped under two categories as utilizing instructional technologies (f=47) and effective learning activities (f=44). They stated that making more use of animations (f=22) and making more use of videos related to the topic (f=10) are to attract students' interest in the lesson and to realize effective and permanent learning. The desire for making use of more educational materials (f=15) is to enrich the teaching process more effectively.

The pre-service teachers, who had the idea of better planning the time (f=15) under the category of effective learning activities, stated that they could not make effective time management because they were excited, unexpected situations, and they were inexperienced. The expressions of doing activities that will make students more active (f=10) and using more engaging teaching techniques that will attract students' attention (f=8) and interest to make more permanent learning by students. Pre-service teachers also emphasized that preparing an effective presentation (f=5) which includes visual objects rather than theoretical information and writings would increase students' interest into the lesson. In the category of effective learning activities; desiring to increase the assessment activities (f=3), making practical applications (f=2) and include up-to-date information (f=1) are among the issues they want to include in the process in order to consolidate the concepts explained at the end of the topic and to realize permanent learning.

Examples of some of the statements given by the pre-service biology teachers' considering points of the redesigned course are as follows:

B3: "If I were present the lesson again, I would have adjusted the time better and I could have shown an effective animation. There could be extra up-to-date information about associated it with daily life."

B4: "I would pay attention to the activities that activate the students about the subject, to use animations that would increase the student's interest in the subject. By doing experimental activities on the acid-base balance in foods, I would help the concepts to be learned better and I would use more materials."

B11: "I would use different teaching techniques by doing more course models and animations that were more interesting and remarkable for students."

B12: "I don't want to add or subtract this process because I think that I explained the subject in accordance with the secondary school biology textbook and curriculum in my presentation with the necessary technologies."

B16: "If I were to present it again, I would consider adding a few more animations in the process. Because I realized using animations are more effective in teaching. The materials I used were very effective and I can increase my materials even more as it enriches the process."

B18: "I would provide more effective learning by increasing the number of animations. I would also try to provide permanent learning with more videos and movies related to the lesson."

B21: "If I wanted to redesign this process, I would be cautious about using time more carefully."

Conclusion and Discussion

The result of the research was indicated that pre-service teachers used visual materials, smart board, computer, animations, internet, video, projection, Lab-Quest, educational software and microscope as an instructional technology in their courses. They stated mostly that providing a better understanding of the subject matter, ensuring permanent learning by students, concretizing abstract concepts via visualization, increasing the students' motivation by using these technologies. These activities make the students more successful in their lessons. Some of the similar studies also support the same results (Armstrong et al., 2005; Bell, 2002; Glover, Miller, Averis & Door, 2007; Higgins, Beauchamp & Miller, 2007). Some studies about using digital experimental tools in science lessons make the students more successful as a result of making attention of students to the experiments (Atıcı, Gökmen & Taffi, 2016; Boniec, Valazquez, & Joyce, 2011; Rodrigues, Pearce & Livett 2001; Thornton & Sokoloff, 1998). After their presentations, some of the participants defined some difficulties while they were presenting the lesson. These difficulties were categorized related to the use of the technologies, personal problems, time-related problems and physical environment problems. At the end of the research, the opinions about considering points of the redesigned their course. As a result of the research, it is understood that given opportunity to the pre-service teachers could make them to raise their awareness in terms of their professional development.

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