Pre-Service Science Teachers' Perceptions Of Technology Literacy

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ABSTRACT
Science literacy contains understanding technology. Therefore, it raises questions about the role of technology in science education. The aim of the study is to investigate pre-service science teachers' perceptions of technology literacy. Phenomenography served as the methodological framework for the study to gain in-depth insight about the nature of technology literacy in science education. The pre-service teachers discussed about the concepts associated with the key components of knowing, learning, and thinking within technology's everyday experiences, during the interviews. The responses of the pre-service teachers to the questions in the interviews were evaluated and according to this evaluation it was determined that their perception of technology literacy was separated into categories. The findings are expected to provide a basis for discussion about using technology literacy to foster future teachers' instructional efficiency.

Keywords: Pre-service science teachers; science education; technology literacy; phenomenology

INTRODUCTION
Technology affects dramatically our lives, so their growth in education for instructional use has increased (Spotts, 1999). There is much discussion about the integration of technology into education from all disciplines (Georgina & Olson, 2008).

When considered in terms of education, the use of new instructional technologies is multidimensional. It includes the possible use of new or revised materials, teaching approaches and the possible alteration of beliefs (Fullan, 1991). The primary task of technology in education is to support both instructional technology and student learning technology. This includes technology to enhance and support communication between student and instructors (Georgina & Olson, 2008).

Today's information and communication technologies can be addressed to science education as an alternative teaching way. Furthermore, science and technology is a compulsory subject between the grade 4 and 8 in the Turkish Educational System and the education system is expected to produce technologically literate students (Turkish Ministry of National Education, 2005). Therefore it is important to use and understand technology. Russell, Bebell, O'Dwyer, and O'Connor (2003) have stated the quality and availability of educational technology in schools have increased significantly along with the technological literacy of teachers and students.

Schrum (1999) reported bulleting points relating to teacher technology training: it takes considerably longer to learn about technology for personal or pedagogical use than learning a new teaching model; access to the new technology at school and at home is essential; fear of the unknown must be addressed; the use of new technology may require teachers to reconceptualize the ways in which they teach. Therefore, it is important that pre-service teachers to be technology literate.

Technology and literacy were found to be the subjects of ongoing debate in several fields of study (Lewis & Gagel, 1992).Technological literacy means that an individual should have the capacity to "design, develop, control, use and assess technological systems and processes" (Shackelford, Brown & Warner, 2004, p. 7). Davies (2011) has stated that understanding technological literacy involves three levels: (1) awareness, (2) praxis (i.e., training), and (3) phronesis (i.e., practical competence and practical wisdom). Hansen (2003) has indicated that technology literacy as an individual's abilities to adopt, adapt, invent, and evaluate technology to positively affect our life, community, and environment. Eisenberg and Johnson (2002) stated that a technologically literate person can use technology as a tool for organization, communication, research, and problem solving.

It is important to critically analyze technology literacy and how we evaluate successful integration of technology into instructional situations. Therefore, ideas in the minds of teacher candidates about technology literacy have been studied in depth with phenomenographic approach. The aim of the phenomenographic research is to see the

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world from the point of view of learners (Ashworth & Lucas, 1998). The phenomenographic method, the first contribution to education; is related to the student's learning and defines the diversity of experience in the training process, the second contribution; identifies the qualitative diversity of the student's understanding of the basic issues (Trigwell, 2006). Phenomenological themes may be understood as the structures of experience (Van Manen, 1990).

At this point, in this research, the matter of emphasis seemed to center on technology and literacy. If educators know the views of students' minds, they can arrange the technology learning environments. This study' s aim was to determine students' deeper understanding of technological literacy. There is a limited number of studies using qualitative methods to explore students' perceptions of technology literacy (e.g., Davies, 2011; Gagel, 1997). Results of the study provide in-depth information about pre-service science teachers' views about the implementation of technology in science class.

Teachers should be eager for using technology and evaluating appropriate technology integration first in terms of why we are using the technology, then how well the technology was used to accomplish the learning task. An important part of the instructional technology discipline will always include developing new ways to use technology in educational situations. Training technology users will always include becoming aware of and providing practice with new technology (Davies, 2011). Therefore, to investigate teacher candidates' views on the use of technology may ensure their potentials of integration of education.

Though the data is from a limited population, it helps describe what their thinking. Another possible limitation is in the data collection process. The data was only collected through interviews. Observations of the teachers in their classrooms could be helpful to verify the information they provided during face to face interviews. It was hoped this would provide information beneficial for pre-service science teachers encouraging greater use of technology in science education.

This study was designed to answer the following two main research questions:

1. What are the pre-service science teachers' conceptions about technology and technology literacy?
2. How do the pre-service science teachers'self-perceptions of technology literacy in educational practice?

THE STUDY

The qualitative research method used in this study. The purpose of this qualitative phenomenological study was to explore pre-service science teachers' ideas and perceptions of technology literacy. Quantitative research is generally based on determining, predicting, or testing specific causal relationships based on certain variables, (Creswell, 2005). Ethnography, case study, grounded research theory, narrative, and phenomenology are examples that are more commonly used (Creswell, 2005). This type of qualitative inquiry, phenomenology, was selected for this study because the purpose of this research was to understand a particular phenomena, that is, the perceptions of technology literacy of pre-service science teachers. This approach focuses on exploring lived experienced of participants with rich descriptions from the perspectives of the participants who experience the phenomenon. According to Marton and Booth (1997) with the phenomenographic approach people how they understand certain situations and issues, how they understand, how they make sense and how they interpret are analyzed. Phenomenological research uses rich and distinct descriptions of students' perceptions for insight and understanding about the phenomenon (Moustakas, 1994, p. 101).

Sampling in a phenomenographic study aims that capturing the dimention of variation in perspectives (Bruce et al., 2004). Therefore, the participants of this study were selected purposefully to capture the variations on the nature and use of thought experiments. In purposeful sampling the goal is to select cases that are likely to be information rich with respect to the purpose of the study (Gall, Gall & Borg, 2003, p.165). The participants for this study consisted of pre-service science teachers who had experience with computer instruction from different perspectives, and who volunteer to participate in this study. The sample consisted of 10 pre-service science teachers which took computer courses. Of these participants, five were female and five were male. The research was conducted in Faculty of Education in the spring semester of the 2014-2015 academic year.

Data collection methods of phenomenological research include in-depth interviews, observations, and documents. The most common interview type used in phenomenology and fundamental to many qualitative researches is the semi-structured interviews (Creswell, 2007). In this study, the semi-structured interviews were carried out in order to examine further thoughts of the participants. The answers received were recorded by the researcher by taking written notes. Each participant's interview lasted for approximately 30 min.

In the analysis of data with phenomenografic approach, interviews recorded with the sound recorder first. In this

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method these records are transcripted as full compliance with the orginal disscussions. The data written in the paper are divided into proper categories. Researchers using this method should establish clearly categories (Marton, 1994). In this study data were analyzed using Giorgi's (1997) method of descriptive phenomenology under four stages: data coding, developing themes, organizing codes and themes, and describing findings, stated by Yildirim and Simsek (2008). The researchers looked at and listened to the recorded responses of the participants and discussed them. The transcripts were examined by different researhers and this multiple examinations contributed to the trustworthiness of the analysis. Findings are presented in the next section.

FINDINGS

To find out students' perceptions of technology literacy, the responses of students obtained from interviews were analyzed in detail and can be seen underneath the related theme. The interviews focus on the technology literacy is divided into basic headers. Responses were categorized around five thematic topics: (1) definition of technology, (2) definition of technology literacy, (3) features of technology literate individuals, (4) importance of technology literacy, (5) the implementation of technology literacy in science education. Results of this study were presented under thiese categories. Themes, codes and categories are presented in tables. Short quotations from students' responses have been given as an example.

The term technology is a component of the technology literacy, therefore the interviews started with this question: "What is technology?". The students' views of technology are presented in Table 1.

Table 1: Students' definitions of technology

Theme	Categories	Codes	Examples of Definitions
Technology	Software	Programs	"It is a set of programs that facilitate human life."
		Applications	"It is a communication tool that enables communication with the help of applications."
	Hardware	Device	"They are devices that make life easier."
		Computer System	"Technology is the name given to the totality of machines called computers."
	Improvement	Invention	"They are inventions that help the innovations in the world."
		Innovation	"I think that technology innovations are made to make life easier "
	Knowledge	Science	"It called technology that innovation associated with science."
		Information	"Developments that can be carried out with the knowledge."

The categories were obtained from definitions of the students are given in Table 1. Referring to Table 1 it was seen that the technology was not fully defined by the teachers' candidates. They had partial understanding this concept. Although definitions were correct, no participants had the full correct response. They generally believed that technology was the same thing with the computer. They gave lacking answers.

They were asked how they define technology literacy during the interviews. Definitions of students about technology literacy are given inTable 2.

Table 2: Students' definitions of technology literacy

Theme	Categories	Codes	Examples of Definitions
Technology literacy	Producing technological devices	Inventing	"Technology literacy is to make technological tools."
		Striking out	"Technology literacy is to make scientific discoveries using technology."
	Producing software	Writing programs	"Technology literacy is to be able to write computer programs and applications."
	Using technology usefully	Following developments	"Technology literacy is to keep track of technological developments."
		Learning developments	"Technology literacy is the use of technology to learn what's new."
	Being expert	Installing and repearing	"Technology literacy is to be successful in the installation and repair of technological tools."

As seen the Table 2 none of the participants could identify this concept correctly. Some of the students thought that technology literacy was to repair technological devices. Some of them put forward that technology literacy

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was writing programs. Also some participants said that this term meant following the developments. They gave partial correct answers.

To provide deeper understanding of technological literacy, students were asked to technology literate individuals' features. This theme is given in Table 3.

Table 3: Students' responses about features of technology literate individuals

Theme	Categories	Codes	Examples of Descriptions
Features of technology literate individuals	Profession	User	"They should use the newly developed programs."
	Curious and progressive	Curious	"A person who investigated knowledge on the internet from many sources and websites."
		Progressive	"It is a person eligible for innovation and development."
		Follower	"It is person who follows the science and technology magazine and journals."
	Demonstrating products	Productive	"These people should have research that has been improved science and industry domain."

Responses of the students were correct, but not complete. The technology literate person should be curious, progressive, productive etc. but he/she does not have to be professional.

Considering the scope of science education, students were asked to importance of technology literacy and implementation of technology literacy during the interviews. Table 4 and Table 5 indicated participants' interpretations. Their views were divided into two categories: positive and negative, because responses focused similar views codes were not given for these themes. Examples of interpretations also are given in these tables (4 and 5).

Table 4: Students' interpretations about importance of technology literacy

Theme	Categories	Examples of Interpretations
Importance of technology literacy	Positive opinions about importance of technology literacy	"Technology literacy teacher can prepare slides and can teach lessons in this way in class."
		"To be a technology literate person provides easy access to the information. It is necessary to keep pace with the evolving world."
		"Science education and technology related. Therefore, it is important technology for science education."
		"To be a technology literate person benefits to follow innovations and developments."
	Negative opinions about importance of technology literacy	"I am not technology literate person because I am not writing a computer program. I think it is not very important element for a teacher."
		"I do not understand the technology. When I have a problem with my computer, I take it and go to service. If I were computer literate person I could do it myself. But it is not important thing for a teacher."

Pre-service science teachers' interpretations about the implementation of technology literacy in science education are given in Table 5.

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Table 5: Students' interpretations about the implementation of technology literacy in science education

Theme	Categories	Examples of Interpretations
The implementation of technology literacy in science education	Positive opinions about the implementation of technology literacy in science education	"Instructions by using smart boards and projection, teachers is important for science education."
		"Everyone who use the computer is technology literate person. At the same time, Teacher who use the computer in the class is the technology literate person."
		"The technology used during science experiments."
		"Meaningful learning can be accomplished by making the instructions with the videos."
		"When the technological tools used in the experiment break down, technology literacy teachers can easily solve this situation."
	Negative opinions about the implementation of technology literacy in science education	"Because the use of technology in science lessons would be a waste of time, technology literacy may not important to this course."

As seen these tables some of the participants thought that technology literate teachers was important for science class environment, but others thought that technology literacy was not a necessary thing. Teachers who had negative ideas were participants who did not identify the concept of technology literacy correctly.

CONCLUSIONS

The research question focused on how pre-service science teachers defined technology literacy, for which purposes they used technology, what they thought about the importance of technology literacy in science class, and which guidelines they suggested for classroom practice. This study employed a qualitative design to gain an in-depth understanding about the nature of technological literacy in science education. Data was collected through in-depth interviews with pre-service science teachers.

Pre-service science teachers defined technology as software, hardware, improvement, knowledge. Although their definitions were correct, none of the participants responded fully accurate. Another theme was technology literacy and it was answered inadequately or incorrectly. Participants had wrong views about technology literacy and technology literate people. Technology literate people know what the technology is capable of, they are able to use the technology proficiently, and they use technology effectively (Davies, 2011). One of the findings was that pre-service science teachers generally emphasized that technology literate person could write programs, they could repair technological devices.

Considering the scope of science education, during the interviews students were asked to importance of technology literacy and implementation of technology literacy. Their views were divided into positive and negative categories. Some of the participants thought that technology literate teachers were important for science class environment, but others thought that technology literacy was not necessary thing. Teachers who had negative ideas were participants who did not correctly identify the concept of technology literacy. Some of them uttered that technology literacy was effective in science education and technology should use in lessons.

When the results of the study were examined as to the understanding of technology in education, it was seen that the pre-service science teachers were not fully aware of the meaning of literacy Some of technology literacy themes, which founded this study, were similar to Gagel's (1997) research. In curriculum design, the themes can serve as conceptual guides in the formulation of decision rules for the choosing of competencies and educational strategies. In addition, these themes answer the purpose to establish a universe of discourse in which a rational discussion of technological literacy can proceed (Gagel, 1997).

The interesting finding was some of the pre-service science teachers considered that using technology did not contribute to learning environment. This view about technological literacy revealed that pre-service teachers should be informed about educational technology. Learning environments should be designed to help future teachers understand, evaluate, and promote effective technology integration.

If educators know the views of students' minds, they can arrange the technology learning environments. Therefore, this study is expected to contribute to the training pre-service science teachers as a technology literate people.

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While people maintain to use technology, what it takes to be considered technologically literate will change. Technological literacy, like its functional agent technology, is an everchanging phenomenon. However, technology is defined today, we can be certain that by future it will have changed (Gagel, 1997). Under light of the research, it can be said that an ability to read and write in a technical language with proficiency should be an obvious goal for a curriculum claiming to advance technological literacy.

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