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Evaluation of Teacher Candidates' Views on Scientific Research Methods

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ABSTRACT The purpose of this study is to explore the views of teacher candidates against a research method course. The study employs qualitative research methods. An open-ended protocol was used to collect the data. A total of 93 teacher candidates participated in the study. Forty-five (45) teacher candidates came from the Science and Technology Education Department, while forty-eight (48) of the participants were from the Turkish Language Education Department. An open-ended survey instrument was applied to teacher candidates enrolled in research method courses during the spring semester of 2011-2012. During the course, students were also asked to plan and implement a small scale research project in groups of three or four. The responses were gathered at both the beginning of the semester before the course content was introduced and once again at the end of the semester after the completion of the course. The results were compared by the researchers and meaningful re-occurring themes were established from the data. The results revealed that the students' perceptions toward scientific (academic) research had changed considerably. Students reported that academic research was not as easy as they had previously thought, nor could the results be predicted from the beginning.

INTRODUCTION

Science has been described as a continuous and dynamic activity stemming from a compilation of information (Cleminson 1990; Giddings 1982; Lederman 1983; Ryan and Aikenhead 1992) and as an attempt to understand and explain the physical universe of humans (Turkmen 2006), among many other definitions. The reason behind such a variety of descriptions stems from science's ever developing and changing nature coupled with its lack of explicit limits. A researcher will notice that within the current literature, the concepts of *bilim* and *fen* are perceived to be different from one another; each with its own, separate meaning. Despite this reality, these two concepts are used as synonyms in many studies in Turkish. This specific situation has caused students to limit their understanding of the word *bilim* strictly to the meaning held within the word *fen* which has further led them to misperceive the inherent differences and nuances between the two concepts. The reason behind this ambiguity may be explained by the fact that when a translator translates the English word "Science" into Turkish, he sometimes uses the word *fen*; whereas in others, he uses the word *bilim* without defining his reasons for using different translations; or even worse, in a completely indiscriminate fashion. This same confusion is observed in the concepts of "science" and "technology" as emphasized by McComas (1998) in his book chapter titled: "the principal elements of the nature of science: dispelling the myths". According to McComas, one of the wrong beliefs held about science is that "Science and technology are seen as identical;" whereas an important distinction of science is that it is need not be implemented in order to be considered science. Collecting knowledge only for the sake of knowledge is known as pure science (McComas 1998).

The two concepts of (1) science and of (2) scientists are most commonly scrutinized in formal educational institutions. One of the most important goals of modern education systems is to provide individuals with scientific literacy (Deboer 2000). Scientific literacy may be defined as one's ability to ask questions about the results of experiments that s/he finds interesting, to give answers to these questions, or to make decisions that affect one's daily life in light of these experiments. Such a definition entails that one has not only the ability to describe and explain, but also to make speculations regarding the natural phe-

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nomena with which he finds him/herself in contact. Moreover, scientific literacy requires one to be informed enough to be able to make decisions in-line with national or regional areas of scientific interest. As such, a literate citizen may be defined as one who is able to make evaluations regarding the defining characteristics of, the principle sources of, and the various techniques brought about by scientific information (NRC 1996; Bell 2008).

Within the overall framework of science education, one of the recent concepts within the domain of scientific literacy on which reformation movements have focused is the birth of science (Bell and Lederman 2003). When exploring the current literature, it is observed in both Europe and the US that the subject of science's birth has amassed a large amount of interest thereby forming the base for a number of works focusing on either developing the scope and/or perception of science. In Turkey however, even if such interest has yet to be expressed, a similar trend is beginning to be observed. Only a few years ago did interest in this subject begin to increase; and one of the most visible evidences for this increase is observed in the increase in research pertaining to the birth and perception of science focusing on teacher candidates (Guzel 2000; Kilic 2003; Celik 2003; Gurses et al. 2005; Akgul 2006; Tasar 2006; Turkmen 2007; Timur et al. 2013; Demirbulak 2012; Timur et al. 2013a).

According to new approaches in teacher training theory, a teacher is expected to also be a researcher. As such, it is possible, if not required, for teachers to play an active role in creating information based on their own observations stemming from their school and/or classroom experiences and then to contribute to finding solutions to whatever problems they may incur. However, it is not enough for teachers to rely solely on the generalizable information of researchers in order for them to make effective use of this information or simply to increase the quality of education because teachers may have difficulty reconciling such theoretical information with their own observations (Elliot 1991). During the implementation process, they may be able to provide crucial contributions to the questions researchers face in their attempt to improve educational quality. Such collaboration will then lead to a more natural and valid research project. As such, the research techniques and skills that teachers learn to aid them in solving such problems will enable them to be more successful in their professional lives. Teachers will be able to balance their roles as a classroom teacher and a researcher (Koklu 2001; Er 2013). For these reasons, the need for contemporary teachers to gain the knowledge and skills required to become competent researchers, for their conclusions based on classroom phenomena to be appropriate and reached quickly, and for the ability for them to successfully implement their findings in their classroom is high.

It has become expected for teachers of the 21st century to be able to guide students in reaching information for themselves, to follow developments in their content area(s), to perceive changes, to constantly improve their classroom management and organizational skills, and to collaborate with their colleagues. In order to reach these goals, questionnaires rating teacher quality and development have been developed in both general and content specific areas of teaching proficiency. When analyzing proficiency in general content areas, under the sub-section "Commenting on data analyzed, student development, and providing feedback to learning," the proficiency standard "Tracking and evaluating learning improvement" clearly states that teachers are expected to be proficient in being able to perform scientific research. Included in this area of proficiency are the benchmarks of being able to (1) choose and implement the appropriate research technique, to (2) analyze data through the use of information and communication technologies, to (3) chart the results, and to (4) provide commentary on the results (Ministry of National Education [MEB] 2008). Consequently, the requirement for teachers to be both researchers and literate in the field of research has found precedence within the current politics of teacher training.

As per the proficiency standards as defined by the MEB, a teacher who, as a researcher, examines the problems within his/her classroom environment, who actively attempts to find solutions to them, and who then implements these solutions has the potential to be a more highly qualified teacher than otherwise. Such are the teachers that Yildirim and Simsek (2008) mention when they describe a teacher who not only considers research and implementation to be under one roof, but who also makes implementing research a part of his/her daily professional practice. As per the Teacher Training and Develop-

ment Administration, in a report titled, "General Proficiency Standards for Teachers" (2006), published by the MEB, it is stated under a number of proficiency standards that a teacher must be able to research solutions for problems occurring not only in his/her own classroom, but also for those problems occurring throughout the school. Specifically:

Teachers are expected to perform action research in order to improve the teaching and learning processes and are also expected to plan and implement action research in order to contribute to the finding solutions to schoolwide problems.

As such, since scientific literacy within the field of education, especially for the classroom teacher has gained precedence, it is thereby of the utmost importance that teachers learn the nature of science and scientific research as well as how to implement them into their own professions.

After teacher training was transferred to universities and the developments between 1982 and 1997 are analyzed, one finds that classes such as "Research Techniques," "Research Methods in Education," and "Research Methods" were added to the curriculum to be taught in Turkey's various Schools of Education. In 1997, however, all classes focusing on research proficiency were removed from the curriculum entirely. Then during the 2006-2007 academic year, classes focusing on research were again added to the curriculum in order to increase the intellectual skills of potential teachers (The Council of Higher Education 2007).

In today's "information and technology age," the definition and implementation of information have been differentiated in a parallel fashion. Although unused information is considered to be meaningless in Turkey, it may gain true value by being implemented through scientific techniques. If it is assumed that teachers constitute one of the most important groups of professionals who have the ability to improve individuals' life standards within society, the importance of the class, "Scientific Research Methods," is easily understood.

Within this new program, the goal of this class is to analyze the basic concepts related to science and research, the functions of science, the types of research, the basic characteristics of social science research, research methods, the steps of scientific research, data collection and analysis methods, writing research reports, and making use of research results, among other topics. It is expected that the students of this class will develop, in general, proficiency in the following areas (Kurt 2009):

- The ability to describe the basic principles of scientific research,
- The ability to reach information through various information sources,
- The ability to compare different types of scientific research,
- The ability to recognize the general characteristics of both qualitative and quantitative research
- The ability to describe the steps of the scientific research process, and
- The ability to describe the ethical principles of scientific research.

It is believed that by placing the class, "Scientific Research Methods," into the current curriculum for teacher candidates, further attention will be given to making "researcher-teachers" by those interested in the field of education in Turkey. When analyzing the related literature on this subject, it is apparent that not enough work has been done in (1) helping students and teachers develop a sufficient level of proficiency in performing and implementing scientific research (Nartgun et al. 2008) or in (2) preparing the curriculum for the class "Scientific Research Methods" (Tay et al. 2009). Moreover, although a number of research projects focusing on Scientific Research Methods has been conducted, many of them have stated negative attitudes held by students (Cashin and Elmore 1997; Elmore and Vasu 1980; Fullerton and Umphrey 2001; Wise 1985) which has led to a low display of performance in this class (Zeidner 1991). There is also literature supporting that students develop stereotypes in early grade levels such as 4th and 5th against science/research and researches (Ozel 2012; Ozgelen 2012; Usak et al. 2013).

In this research project, the perceptions of teacher candidates in both Science and Technology Education and Turkish Language Education toward the one-semester class, "Scientific Research Methods," have been collected and then compared. Specifically, this project has endeavored to ascertain and compare the perceptions of these two groups in regards to their knowledge of scientific information and methods as well as to reveal what expectations teacher candidates might hold regarding this class and what they have learned after its culmination.

METHODOLOGY

The Participants

The focus group of this research project consists of students from Turkey studying Science and Technology Education and Turkish Language Education who are registered in the class, "Scientific Research Methods," during the 2011-2012 Fall semesters. Although the total group consisted of 93 candidate teachers from Canakkale Onsekiz Mart University's School of Education, the group may be broken down into two smaller groups; one of 45 candidate teachers studying Science and Technology Education and the other of 48 studying Turkish Language Education during their sophomore year.

Developing Data Collection Means

This research project was designed to be a qualitative work. The most defining characteristic of a qualitative research project is that it may investigate in greater detail one or a few areas of specific interest. Specifically, the factors related to a specific situation may be observed from "the grand scheme of things" thereby allowing one to focus on how a specific situation is affected or what kind of an effect it has on the rest of the components (Yildirim and Simsek 2008). As for the means by which data was collected for this work, the researchers employed open-ended questions both before students began the class, and after having completed it. Prior to beginning the class, the teacher candidates expressed their expectations from the class; and upon the class's completion, they expressed what they had gained after having concluded the class.

Evaluation of Data Collection Means

When performing qualitative research, open-ended questions are often made use of because they allow for the respondent to express his/her opinion openly and freely and in the formant s/he chooses. The benefits of such questions allow for the researcher to collect unexpected and unplanned answers which thereby aid in expanding the potential scope of the project while at the same time allowing the researcher to be owner of a more detailed knowledge base (Buyukozturk 2005). In formulating the open-ended questions used in these surveys and to ensure their validity, the researchers has benefited from professional opinions and experience. After the responses to these open-ended questions were evaluated by three different researchers, the frequency and percentages of similar and different opinions were then charted. The opinions of the candidate teachers as expressed in their responses have been conveyed verbatim in the "findings" section of this report.

RESULTS

In this section, the responses of teacher candidates from both the departments of Science and Technology Education and Turkish Language Education regarding the class, "Scientific Research Methods," have been illustrated in various tables below. The surveys from which the information was gathered were conducted both before the class's inception and after its completion. Open-ended questions were the only question format employed in the surveys. The responses have been charted according to frequency and percentage. The frequencies and percentages of the opinions illustrating what teacher candidates studying Science and Technology Education expect to learn from the class, "Scientific Research Methods" have been illustrated in Table 1.

Table 1: Opinions expressed by teacher candidates studying science and technology education

Opinions	*f*	*%*
Learning which components of scientific research one must take into consideration while performing scientific research	28	25
Gaining knowledge in experiment implementation techniques	23	21
Learning how to make decisions on how to reach correct and reliable information	14	13
Gaining proficiency in making better observations and collecting data	12	11
Learning how to solve a single problem under various perspectives	9	8
Understanding and recognizing how scientific data is collected	7	6
Ability to define the characteristics of a scientist	6	5
Recognizing steps of a scientific process.	5	4
Learning how to question things.	3	2
Gaining knowledge in the development and improvement of science	2	2

According to Table 1, of the 45 teacher candidates studying Science and Technology Edu-

cation, 28 expressed the expectation of "learning which components of scientific research one must take into consideration while performing scientific research;" and 23, the expectation of "gaining knowledge in experiment implementation techniques." These two categories represent the most highly expressed expectations by the Science and Technology Education group. Furthermore, the expectation of "learning how to make decisions on how to reach correct and reliable information" was expressed by 14 teacher candidates, the expectation of "gaining proficiency in making better observations and collecting data" by 12, and the expectation of "learning how to solve a signal problem under various perspectives" by 9. The following three expectations were also expressed: (1) "understanding and recognizing how scientific data is collected," (2) "Ability to define the characteristics of a scientist," and (3) "learning how to recognize on which step of the process one is while solving scientific problems."

In Table 2, the frequencies and percentages of the opinions illustrating what teacher candidates studying Turkish Language Education expect from the class, "Scientific Research Methods" have been illustrated below:

Table 2: Opinions expressed by teacher candidates studying Turkish language education

Opinions	*f*	*%*
Learning the different techniques and methods of scientific work	30	21
Learning how research is to be conducted	25	18
Observing how to use technological tools	21	15
Learning how to teach future students how to conduct research and Observations	18	13
Learning how to teach content more effectively	15	10
Learning how to obtain more reliable information in a shorter time	13	9
Learning how to conduct experiments and observations	9	6
Analyzing articles, books, experiments, and other similar writings	7	5
Developing my researcher and investigative qualitiesLearning how to write Master's and Doctoral theses	54	33

According to Table 2, of the 48 teacher candidates studying Turkish Language Education, 30 expressed the expectation of "learning the different techniques and methods of scientific work;" 25, the expectation of "learning how research is to be conducted;" and 21, the expectation of "observing how to use technological tools." These three categories represent the most highly expressed expectations by the Turkish Language Education group. The following statements summarize the further expectation of this group: (1) "learning how to teach future students how to conduct research and observations," (2) "learning how to teach content more effectively," (3) "learning how to obtain more reliable information in a shorter time," (4) "learning how to conduct experiments and observations,"(5) "analyzing articles, books, experiments, and other similar writings," and (6) "developing my researcher and investigative qualities."

In Table 3, the frequencies and percentages of the opinions illustrating what teacher candidates studying Science and Technology Education gained from the class, "Scientific Research Methods" have been illustrated below:

Table 3: Perceived opinions expressed by teacher candidates studying science and technology education

Opinions	*f*	*%*
I have learned how to sift through literature on scientific research	34	25
I understand what qualitative and quantitative research as well as what dependent and independent variables mean	25	20
I have gained an understanding of what the terms population and sample mean	21	16
I have learned that writing a scientific article requires a great deal of effort	15	12
I have learned that science and scientific research consists not only of science and mathematics, but of many different areas	10	7
I understand that my previous research projects were not very scientific	8	6
I have gained information on how to prepare and implement surveys	6	5
I believe that I can write a scientific article on my own.The "Scientific Research Methods" class has made important contributions to me as a teacher	53	42

According to Table 3, of the 45 teacher candidates studying Science and Technology Education, 34 expressed that they have "learned how to sift through literature on scientific research;" 25, that they "understand what qualitative and quantitative research as well as what dependent and independent variables mean;"and 21, that they have "gained an understanding of what the terms population and sample mean." Among the

other gains expressed are: (1) "I have learned that writing a scientific article requires a great deal of effort," (2) "I have learned that science and scientific research consists not only of science and mathematics, but of many different areas," (3) "I understand that my previous research projects were not very scientific," (4) "I have gained information on how to prepare and implement surveys," (5) "I believe that I can write a scientific article on my own," and (6) "The "Scientific Research Methods" class has made important contributions to me as a teacher."

In Table 4, the frequencies and percentages of the opinions illustrating what teacher candidates studying Turkish Language Education gained from the class, "Scientific Research Methods" have been illustrated below:

Table 4: Perceived opinions expressed by teacher candidates studying Turkish language education

Opinions	*f*	*%*
I have learned how research is to be conducted	32	21
I have learned how to sift through literature and how to prepare a bibliography	28	19
I have learned the phases of research	21	14
I have gained an understanding of the characteristics of both qualitative and quantitative research	16	10
The fact that the lesson was hands-on contributed a great deal to its effectiveness	14	9
I believe that scientific research is a long process requiring a great deal of attention	12	8
I have learned how to form a hypothesis and how research methods are to be conducted	9	7
I have learned how a scientific text is to be prepared	8	6
I believe that this class should be taken at higher levels	7	5
I have learned what difficulties exist in working in groups	5	4

According to Table 4, of the 48 teacher candidates studying Turkish Language Education, 32 expressed that they have "learned how research is to be conducted;" 28, that they have "learned how to sift through literature and how to prepare a bibliography;"and 21, that they have "learned the phases of research." Among the other gains expressed are: (1) "I have gained an understanding of the characteristics of both qualitative and quantitative research," (2) "The fact that the lesson was hands-on contributed a great deal to its effectiveness," (3) "I believe that scientific research is a long process requiring a great deal of attention," (4) "I have learned how to form a hypothesis and how research methods are to be conducted," (5) "I have learned how a scientific text is to be prepared," (6) "I believe that this class should be taken at higher levels," and (7) "I have learned what difficulties exist in working in groups."

DISCUSSION

The class, "Scientific Research Methods," consisted of the following topics: (1) concepts related to science and research, (2) the functions of science , (3) the types of research, (4) the basic characteristics of social science research, (5) research methods, (6) the steps of scientific research, (7) data collection and analysis methods, (8) writing research reports, and (9) making use of research. The class curriculum was designed and implemented in such a way so as to enable students to gain a proper understanding of these topics and concepts.

According to the results of this research project, the two groups of teacher candidates studying Science and Technology Education and Turkish Language Education each held very different expectations before participating in the class. Teacher candidates studying Science and Technology Education viewed the methods of scientific research and science education as being identical with each other, and their expectation of "gaining knowledge in experiment implementation techniques" supports this opinion. Teacher candidates of Turkish Language Education however, expressed expectations relating to learning the techniques and methods to be used while performing research as well as learning how research is to be performed. Teacher candidates studying Turkish Language Education displayed more interest toward the Science and Technology aspect of the class. This group furthermore expressed the opinion that this class should be taken by students in higher levels. Finally, the expectation of developing one's skills in collecting data and conducting observations as well as the opinion that performing scientific research is a long and difficult process were expressed by both groups.

After having completed the class, "Scientific Research Methods," both groups of students expressed different opinions in regards to what

they perceive to have gained from the class. In general, the gains that teacher candidates studying Science and Technology Education expressed revolved around the technical details of the class. Their opinions related to "searching through field literature," "qualitative-quantitative research regarding the population and sample," and "dependent-independent variables" reflect this conclusion. One of the opinions held by Science and Technology Education students worthy of note is that of "having learned that science and scientific research consists not only of science and mathematics, but of many different areas." It is also observed that the expectations held by teacher candidates studying Turkish Language Education previous to the class's inception match are congruent with what they perceived to have gained after completing the class; the opinions of "I have learned how research is to be conducted," "I have learned how to search through literature and how to prepare a bibliography," and "I have learned the phases of research" being those most highly expressed. Both groups, however, expressed the same opinion that "I understand that conducting and writing scientific research requires a great deal of effort."

In a similar study, Akgun (2012), in order to indentify the "perceptions and expectations of teacher candidates in regards to the class 'Scientific Research Methods,'" the author surveys the opinions of elementary and middle school mathematics teacher candidates. In general, he reached the conclusion that allowing students to analyze articles in their Science Research Methods class made them more aware of the scientific research process while at the same time showing them that this very process is applicable in their professional lives. Furthermore, mathematics teacher candidates at the elementary level were of the opinion that this class was unnecessary and that it did not contribute anything to their profession.

In another study titled "Analysis of Student Opinions towards the class 'Scientific Research Methods' in the Computer and Education Technology Education Department" by Kurt et al. (2011), student opinions were compared in terms of gender, academic success level, and social class status. According to the results of the study, females, students with high grades, and those of upper-class backgrounds expressed more positive opinions toward the class "Scientific Research Methods" than their respective counterparts.

In a separate study, Nartgun et al. (2008) aspired to detail teacher candidates' perceptions of self efficacy regarding both the methods and teaching of scientific research. The study resulted in a manifest difference in levels of perceived self-sufficiency by students who took the class and by those who did not, with a higher level of perceived self-sufficiency in those who took the class. It was furthermore determined that teacher candidates have an average level of perceived self-sufficiency in regards to their ability to employ the scientific research method in their professional lives.

CONCLUSION

The scientific research method course provided students with an understanding of the research process. It was clear in the student responses that after the course students used more technical words such as: "sample", "literature review", and "variable". The course also improved the students' understanding of the parts of a research project. However, it is important to note that these concepts should go in line with the other subject courses. In that students should be made aware that today's teachers are not just instructors but also researchers. The more the researcher function of teachers emphasized the more the teacher candidates will value the course.

Another point is the fact that teacher candidates felt more competent in reading scientific work from academic journals. One important difference between science and technology education teacher candidates and Turkish language education teacher candidates is the way research is reported. Because the students majoring Turkish language education are more inclined to write and focus on the writing process, they were more aware that written works stemming from research has to be organized in a certain way and have various parts and not just telling of a story.

Another difference between the groups was the realization by the teacher candidates majoring in science and technology education that scientific research is not just about the numbers and can include qualitative elements. The same reference was given by Turkish language education majors and which made them more aware that scientific work is not just about numbers and math and is doable for them.

Although there were small differences between the two groups, the general reaction was that the course is helpful and necessary for teacher candidates. The students have gained an understanding of the scientific research jargon and the terms used in academic writing, which will help them to be better audiences and readers of research, especially in educational practices.

RECOMMENDATIONS

It is, however, possible to develop further conclusions and recommendations regarding the class "Scientific Research Methods" based on the findings of this study. Although it is true that this class has contributed to expanding the perspectives of the students enrolled in it, it is recommended that it be taught in two parts covering an entire academic year due to the amount of content it contains. Furthermore, due to the content and particular characteristics of this class, it might be appropriate for it to be offered as an elective class to students in their final year. In doing so, it may encourage teacher candidates to continue their educational career in the university beyond the graduate level. Finally, by increasing the number the in-class and out-of-class practices, the overall quality of the class may be brought to a higher level.

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