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PRESERVICE SCIENCE TEACHERS' VIEWS ABOUT SCIENTIFIC INQUIRY

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Abstract:
The goals of this study are to determine the Turkish preservice science teachers' views about scientific inquiry. In this research, simple descriptive survey is conducted for the purpose of describing pre-service science teachers' views about scientific inquiry. For this purpose, "Views about Scientific Inquiry (VASI) Questionnaire" was utilized to collect data. Seventy two senior preservice teachers in a Science Teacher Education Program at a large university participated in this study. Data were collected using qualitative research methods of individual open-ended instrument, and semi-structured interviews. Findings revealed that the majority of the preservice teachers' responses of the scientific inquiry aspects are naive. On the other hand, for only three aspects of SI, the pre-service science teachers have informed views. These aspects are inquiry procedures are guided by the question asked and all scientists performing the same procedures may not get the same results. In this research "All scientists performing the same procedures may not get the same results" was the best understood aspect of inquiry and "Scientific investigations all begin with a question" was the least understood aspect of inquiry. This lack of aspect means that senior PST were not well aware that investigations are based on questions. Also, data analysis indicated that preservice science teachers have difficulties with defining the experiment, observation, data, evidence, and different scientific methods.

Keywords: pre-service science teachers; scientific inquiry; scientific literacy; views about scientific inquiry

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1. Introduction

Science Education Reforms in different countries stated that science includes not only 'the products' of science but also 'the processes and characteristics of the scientific enterprise' (Roberts, 2011). Through these reform movements, a sufficient understanding of science and the scientific enterprise became the main goal of science education (AAAS, 1989; NRC, 1996; Laugksch, 2000; Roberts, 2007; Liu and Lederman, 2007). In other words, it was stressed that it is important to develop current understandings of the nature of science and scientific inquiry of learners. Additionally, in the science curricula of many countries around the world, it is expected that students must be educated scientifically literate. The rationale behind this goal is to develop the next generation as scientifically literate citizens (Chin, 2005), so that a scientifically literate population can have a strong knowledge about how scientists construct knowledge and what level of confidence they should have about that knowledge. Basically, science education programs have focused on Scientific Literacy that encompasses the ideas of a scientific worldview, science-society relationship and scientific inquiry (Achieve, Inc., 2013; NRC, 2000, 2012). For this reason, scientific inquiry is essential to the development of future generations of scientists, as well as to the development of a scientific-literate population (Lederman, Antink, and Bartos, 2012; Millar, 2006). In the context of science education, scientific literacy requires an understanding of the nature and the processes of science, so that learners can make reasoned decisions, and engage in debate, about scientific issues (Driver, Leach, Millar, and Scott, 1996; Lederman, 1999; Ryder, 2001). Improving learners' interests in scientific inquiry can improve their scientific literacy (AAAS, 1990, 1993; NRC, 1996, 2000, 2011). For example, scientifically literate citizens can know why and how scientists looking at the same data can validly disagree with each other. Scientifically literate people can make decisions about controversial topics through their knowledge about scientific inquiry and scientific practices (Lederman, Lederman, Barto, Bartels, Antink Meyer, and Schwartz, 2014).

Two important aspects that contribute to the notion of scientific literacy are nature of science and scientific inquiry. Although scientific inquiry and nature of science are not independent from one another, some education researchers argue that these understandings are part of the nature of science (Allchin, 2011; Wong and Hodson, 2008). But National Research Council (NRC) and Next Generation Science Standards (NGSS) described these concepts separately as knowledge about scientific inquiry and nature of science (NRC, 1996; NGSS; Achieve, Inc., 2013). Nature of Science is "*the epistemological underpinnings of the activities of science*" and scientific inquiry is the "*process by which scientific knowledge is developed*" (Lederman, 2004, p. 308). According to Schwartz (2004), scientific inquiry is "*characteristics of the processes through which scientific knowledge is developed, including the conventions involved in the development, acceptance, and utility of scientific knowledge*" (p. 8). Scientific inquiry, which represents systematic processes of investigating questions leading to the discovery and establishment of new scientific knowledge, refers to the combination of general science process skills with traditional science content, creativity, and critical thinking to develop scientific knowledge (Millar and Osborne, 1998; Millar, 2006; Lederman, 2009; Lederman, Antink, and Bartos, 2012; Lederman et al., 2014). The categories of scientific inquiry used in this study are based on the description of scientific inquiry in Schwartz, Lederman and Lederman (2008). These descriptions include these aspects: scientific investigations always begin with a question, there is no single set or sequence of steps in a scientific investigation, the procedures followed in an investigation are invariably guided by the question(s) asked, scientists following the same procedures will not necessarily arrive at the same results, the procedures undertaken in an investigation influence the subsequent results, conclusions drawn must be consistent with collected data, data is not the same as evidence, scientific explanations are developed through a combination of evidence and what is already known.

These eight attributes of scientific inquiry are considered science content in science reform documents (Lederman et al., 2012) and understandings about scientific inquiry allow students to recognize how science is distinct from other ways of knowing and where scientific knowledge originates (Schwartz et al., 2008). Engaging students in scientific inquiry is an important component of science instruction that helps students' development regarding scientific literacy. In this case, it is important that teachers must lead students in order to improve understanding of scientific inquiry. And teachers with informed understandings of scientific inquiry can positively impact the views of their students. D'Costa and Schlueter (2013) stated that there are many students who reach the college level knowing how to recite the different steps of the scientific method but fail to understand the process, e.g., the use of variables. Because of this reason, it is important that science teachers must provide opportunities to practice science process and scaffold the various steps of scientific methods (Abd-El-Khalick, 2013; Akerson and Abd-El-Khalick, 2003; Faikhamta, 2013). Through improving students' and teachers' views about scientific inquiry, it is possible to increase the number of scientifically literate citizens (Kober, 2015).

2. Method

This research employs a simple descriptive survey approach. This simple descriptive survey approach is one shot survey for the purpose of describing the characteristics of a sample at one point in time apart from the other approaches of survey research namely cross-sectional and longitudinal (Mertens, 1998). In this research, simple descriptive survey is conducted for the purpose of describing preservice science teachers' views about scientific inquiry. It is hard to understand preservice science teachers' real position about scientific inquiry with Likert- scale instruments, which often force students to position their responses without meaningful understandings of the item statements. For this reason, this research chose open-ended questionnaire as survey instrument and used a qualitative data analysis method to solicit pre-service science teachers' views about scientific inquiry (Creswell, 2008). In addition, semi-structured interviews were conducted with the ten preservice science teachers whose responses are comprehensive and information-rich to validate the researchers' interpretation of analyses.

2.1 Participants

Participants are preservice science teachers of a faculty of education at a state university in one of the cities located on the west of Turkey. Purposive sampling is used to select the participants. In purposive sampling, it is assumed that the chosen people possess the necessary information about the target population (Fraenkel and Wallen, 1996). This study was conducted with 72 (32 females and 40 males) volunteered senior preservice science teachers who had already completed their 3rd year undergraduate program and passed onto the 4th year. These preservice science teachers have already completed the basic science courses, science laboratory courses, nature and history of science course, and one of the science teaching courses (Special Methods of Science Teaching I).

Table 1: Courses at primary science teacher education program

Field courses	Physics I-II-III-IV, Chemistry I-II-III-IV, Mathematics I-II, Special Topics in Chemistry, Special Topics in Physics, Special Topics in Biology, Biology I-II, Evolution, Earth Science, Environmental Science, Human Anatomy and Physiology, Nature of Science and History of Science, Genetics, Biotechnology, Laboratory Courses I-II (Physics, Chemistry, Biology and Science), Astronomy
Professional knowledge	Educational Psychology, Introduction to Teaching Profession, Principles and Methods of Education, Science Technology Program and Planning, Instructional Technologies and Material Designing, Special Methods of Science Teaching I-II, Measurement and Evaluation, Classroom Management, School Experience, Teaching Practise, Turkish Education System and School Management
General culture	Turkish, Ataturk's Principles, Computer I- II, Foreign Language, Turkish Education History, Scientific Research Methods, Community Service Applications)

Their ages ranged between 22 and 25 years, with a median of 23 years. The participants' demographics were similar to the general preservice science teacher population in Turkey.

2.2 Instrument

The data were collected using the Views about Scientific Inquiry (VASI) questionnaire which is an open-ended questionnaire (Lederman et al., 2014). The questionnaire was administered to a sample of 72 preservice science teachers at the beginning of the first semester of 2014-2015 academic years. In addition, these open-ended questions were used in interviews with 10 of these preservice science teachers for internal validity of data analysis of this research (Patton, 2002).

This instrument Views about Scientific Inquiry (VASI) was revised and expanded by Lederman et al. (2014) from the instrument Views of Scientific Inquiry (VOSI) (Schwartz, Lederman and Lederman, 2008). The VASI Questionnaire consists of various open-ended questions suitable for teachers as well as for learners of different ages.

The VASI was originally designed in English. But, in this study, Turkish version of the questionnaire, which was translated by two education research professionals, was used.

2.3 Data Analysis

The aim of this research is to find out preservice science teachers' views about Scientific Inquiry (SI). Therefore, qualitative content analysis was used (Mayring, 2014). As a first step, all answers were transcribed. In the next step, the texts were coded using MAXQda software. The codes were generated from the eight aforementioned aspects of scientific inquiry recognized in existing literature (NRC, 2000; Schwartz, Lederman and Lederman, 2008; Lederman, Lederman and Antink, 2013; Lederman et al., 2014). The VASI items seek to elucidate preservice science teachers' understandings of VASI aspects described in the literature (Lederman et al., 2014). But scoring of the responses of the participants needs to be done by holistic scoring; holistic picture of understandings of SI can be gleaned from considering responses to the VASI as a whole, because although each item targets a particular aspect of SI, comments pertinent to several aspects may be found in a single item response (Lederman et al., 2014).

A rubric for scoring the VASI Questionnaire was developed and refined during the process of coding. Participants' responses on the VASI questionnaire were coded as informed, mixed, naive and unclear (Lederman et al., 2014). If the participants' responses were consistent across the entire questionnaire that was wholly congruent with the target response for a given aspect of SI, they were labelled as "informed." And if a response was not totally consistent with the targeted response or if a contradiction in the response was evident, a score of "mixed" was given. The participants' responses that were contradictory to accepted views of a particular aspect, or provided no evidence of congruence with accepted views were scored as "naive". Lastly, for scores that were incomprehensible, unintelligible, or that, in total, indicate no relation to the particular aspect, they were labelled as "unclear". All questionnaires were scored by two researchers, with scoring discrepancies discussed between these two researchers until 92 % agreement was reached.

3. Results

Findings revealed that preservice science teachers had naive views for the most of the scientific inquiry aspects (A1, A2, A6, A7, A8). Just A3, A4 and A5 aspects were understood well by the preservice science teachers. For example, the best known aspect, "*All scientists performing the same procedures may not get the same results*", yielded 58.3% and "*Inquiry procedures are guided by the question asked agreement between conclusions and data*" yielded 41.6% informed views. Table 3 displays the students' responses for the eight SI aspects targeted in the questionnaire in the four macro/categories.

Table 2: Percentage of students categorized as holding naive, unclear, mixed and informed views across eight aspects of SI (N=72)

Question Number	Inquiry Aspect	Category	Frequency	%
1a, 1b, 2.	A1: Scientific investigations all begin with a question but do not necessarily test a hypothesis	Informed	12	16.6
		Mixed	4	5.5
		Naive	45	62.5
		Unclear	11	15.2
1c	A2: There is no single set and sequence of steps followed in all scientific investigations (i.e., there is no single scientific method)	Informed	10	13.8
		Mixed	3	4.1
		Naive	38	52.7
		Unclear	21	29.1
5.	A3: Inquiry procedures are guided by the question asked	Informed	30	41.6
		Mixed	6	8.3
		Naive	20	27.7
		Unclear	16	22.2
3a.	A4:All scientists performing the same procedures may not get the same results	Informed	42	58.3
		Mixed	4	5.5
		Naive	20	27.7
		Unclear	6	8.3
3b.	A5: Inquiry procedures can influence the results	Informed	30	41.6
		Mixed	8	11.1
		Naive	11	15.2
		Unclear	23	31.9
6.	A6: Research conclusions must be consistent with the data collected	Informed	12	16.6
		Mixed	14	19.4
		Naive	40	55.5
		Unclear	6	8.3
4.	A7: Scientific data are not the same as scientific evidence	Informed	25	34.7
		Mixed	13	18.0
		Naive	30	41.6
		Unclear	4	5.5
7a and 7b.	A8: Explanations are developed from a combination of collected data and what is already known	Informed	18	25
		Mixed	17	23.6
		Naive	20	27.7
		Unclear	17	23.6

* The bold aspects (A3, A4, A5) indicated that teachers have informed views for these aspects.

A1: Scientific investigations all begin with a question but do not necessarily test a hypothesis:

Question 1a and 1b are about experiments and scientific investigations and question 2 targets understanding that a scientific investigation should begin with a question, but not necessarily a hypothesis. Most of the participants thought that investigation in giving example at question 1 was scientific. But the most common type of naive response claimed that the bird investigation was an experiment. In addition, for question 2 the naive count was low indicating that participants were well aware that investigations are based on questions (62.5%). During the coding process, it was also understood that the meaning of the word "experiment" was clear, but unfortunately "observation" was unclear to many participants. They were not able to differentiate between an observation and experiment. At the same time, these learners' responses were almost as many as the naive ones, indicating that many participants do not regard a question as an essential starting point. Some of the mixed answers are "*an investigation needs a question because there must be also a hypothesis*". So these are coded as mixed (5.5%). For this A1 aspect, all three questions must be answered correctly for coding as informed. Just 12 participants were coded as informed. They gave correct answers for three of them. These 12 participants (16.6%) showed a clear understanding of the difference between experiment and observation. And these participants stated that science begins with questions. And 11 participants gave unclear responses (15.2%). For example, one participant said: "*I say yes, because the birds whose beak shapes are different have more advantage, so that they can adapt to the environmental conditions.*" (Participant 12) The answers were not clear and not related with the questions. After analyzing all data regarding A1, it was generally found that many pre-service science teachers have misconceptions about scientific investigations, experiments, observation and hypothesis for aspect A1.

A2: There is no single set and sequence of steps followed in all scientific investigations (i.e., there is no single scientific method):

Question 1c probes understanding that scientific investigations can follow different methods. One of the misconceptions that the participants hold about the scientific inquiry was that scientists use 'one single universal scientific method' to do science and over half of participants (52.7%, n=38) stated this naive view. For example, one participant said: "*There is only one method of scientific research. This occurs in a set of steps. Scientific knowledge must be in accordance with these steps.*" (Participant 23). Another participant had this response: "*There is only one method of scientific research. If the case of a presence is proven, it cannot be rebutted and there are a lot of scientific inquiries that prove the existence of the presence. I have no examples.*" (Participant 67).

A similar response was given by the other participant: "*In scientific researches a single method should be used because everyone should follow the same steps of the scientific inquiry. Everyone should do the same research methods; the same procedure helps us to see where anyone considered in a different way or where there is something wrong.*" (Participant 2).

On the other hand, 24 of these 38 naive responses stated that "*there are many scientific methods that can be done*". However, they could not give any examples for supporting their claim. They might have read the statement of no single scientific method somewhere but did not know the reason of using more than one scientific method to do science. Some participants might have misconceptions about scientific methods. Therefore, their responses were coded as naive. For example, one participant, who could answer yes, but could not give any reasons said: "*Scientific researches can be done by different methods. Because birds have different beaks due to their food that they eat. Different methods are done.*" (Participant 44).

Another response: "*There can be different methods. I don't have any idea for the reason*." (Participant, 15).

21 of the participants (29.2%) wrote that they had no idea so they were coded as unclear. 3 participants had mixed views because their reasons are not totally related to the questions. For example one participant who stated "*Yes, there might be more than one method. Several methods are used for gaining scientific knowledge*". But he also gave this reason "*like hypothesizing, reaching a theory. Experiments and observations are also included*".

Only 10 of participants (13.8%) could give informed views about the multiplicity of scientific methodologies (no single set and sequence of steps followed in all scientific investigations) and could give examples too. One participant who had informed view stated that: "*One research can be done by survey and the other research can be done by observation. The application and the steps of the two methods are different. Despite the differences, they are all accepted scientific because they get conclusions by using scientific inquiry methods*" (Participant, 5).

Another informed response was: "*It can be by experimentation. Or it can be by observation. The things that can not be seen by eyes are examined by experiments. And through observations we can get information by our senses. Then we can get conclusion. To sum up it can be done by more than one way.*" (Participant, 19)

A3: Inquiry procedures are guided by the question asked:

Question 5 assesses participants' understandings about the inquiry procedures that should be guided by the question asked. For this aspect, 30 (41.6%) participants demonstrated informed views recognizing the influence of scientific procedures on the results of an investigation. For example this type of repetition was seen in many participants: "*Because group A does experiment using more than one tire on a few ways by comparing them with each other. But team B uses only one tire so they get information just for one tire*" (Participant, 8).

But percentage of the naive responses is not too low either (27.7%), because some participants did not focus on the given investigated question, instead argued that the road surface may have more influence on a lifetime of tires than the brand of the tire. One participant response was: "*Comparing three tires will waste time. It will be better to examine just one problem and then generalization should be made*" (Participant, 37).

While responding VASI questions, it was clear that the common reason of the naive answers was that students did not read the question properly. Obviously, they missed the point in that question and they could not focus on the 'best procedure for the given question'. A few students (8.3%) could argue that these two investigations were not perfect, they needed to be completed.

A4: All scientists performing the same procedures may not get the same results:

Question 3a assesses understanding that scientists may come to different conclusions. This question drew the most informed responses, with 42 of participants (58.3%) indicating that when scientists are performing the same procedures scientists may obtain different conclusions due to the role of human interpretation, their education life and cultures. One example of this view was given: "*The researchers have* *different thoughts, rights, imaginations, creativities so they may not get the same conclusion"* (Participant, 5).

The naive responses (27.7%) typically argued that similar procedures would always lead to the same results. On the other hand, some responses were right but their explanations were not coded as informed because some participants had misconceptualizations about error. For example, the question prompted the following responses from a participant: "*Maybe they won't get the same conclusions. Because they might miss some points or they might get wrong conclusions. The experiment might have inaccuracies*" (Participant, 66).

A5: Inquiry procedures can influence the results:

This question targets understanding that procedures can influence results, even when the same question is investigated. One of the important research about science education pointed out "*students must not only be adapt at analyzing and interpreting data, but must also be able to compare the results from different data sets generated through a variety of methodologies. As such, they should develop an understanding of the logical connection between the method of inquiry, the specific procedures therein, the data collected, and thus the conclusions drawn*" (Lederman, et al., 2014). This aspect has a big place in scientific inquiry. For example, throughout the history of science technological advances have impacted the common practices of scientists, the results of their undertakings, and knowledge generated. 30 of the total 72 participants (41.7%), whose responses were categorized as informed, recognized the influence of scientific procedures on the results of an investigation. For example one participant said: "*If they apply different processes and they use different ways, they may get different conclusions because they use different ways, materials, and approaches to the same problem statement*" (Participant, 5).They also indicated that various interpretations of the same data set could be available because scientists might have different personal and theoretical orientations.

The naive count of this aspect was low. Only 10 (13.8%) of these responses mentioned about errors in scientific investigations. On the other hand, the unclear count, indicating that participants did not have any idea of this question, was also high (31.9%).

A6: Research conclusions must be consistent with the data collected:

Question 6 assesses the understanding that research conclusions should be consistent with data collected. Students need to understand that the strength of a scientist's claim is a function of the preponderance of evidence that supports it. Findings revealed that only 12 out of 72 participants (16.6%) were able to understand that conclusions should be consistent with data collected. This indicates that few learners could explain that the validity of the claims is further strengthened by the alignment of the research method with the research question, and that claims must be reflected in the data collected. On the other hand, unfortunately, naive responses were very high (55.5%) which showed that participants could not choose the correct option from the data-set. For example one participant's response was: "*The plants which are in* *more sunlight according to the other plants (those in less sunlight) grow faster because plants produce more food and more oxygen through photosynthesis*" (Participant, 47).

Some of the naive responses speculated about the unexpected behaviour of the plants in response to the question 'please explain your choice' (19.4%). These learners ignored the given data, choosing 'taller with more sunlight' based on prior knowledge rather than on the given data-set: "*The data is incorrect. If the light increases, the growth of plant must increase too*" (Participant, 26).

A7: Scientific data are not the same as scientific evidence:

Question 4 focuses on the understanding that evidence differs from data. Students must understand that data are observations gathered by the scientist during the course of the investigation, and they can take various forms (e.g., numbers, descriptions, photographs, audio, physical samples, etc.) and evidence, by contrast, is a product of data analysis procedures and subsequent interpretation, and is directly tied to a specific question and a related claim. But for this aspect, the naive responses were higher (41.6%) than the informed responses (34.7%). Most of the naive responses could not explain the meaning of the evidence. ''*They are similar because they're both information*'' was considered to reflect an inaccurate understanding about the difference between data and evidence. That means participants could not understand the distinction between data and evidence and could not describe how the interpretation of data (i.e., the use of data as evidence) is a potential source of bias. The mixed responses (18.0%) were correct answers but their explanations were not very clear and specific. These are some examples of participants: "*They are different from each other. Gathering data does not mean that it is evidence. Each data is not evidence. But everything that is proven can be data*" (Participant 18). "*Data and evidence are not the same. Data is the result that is gathered through inquiries. Evidence is the proof of the certainty*" (Participant, 59).

One example for informed response, such as, "*They are different in that data does not have to prove anything while evidence is usually used in support of an idea*'' was considered to reflect an acceptable understanding about the difference between evidence and data.

A8: Explanations are developed from a combination of collected data and what is already known:

Question 7 probes the understanding that explanations are developed from a combination of collected data and what is already known. This aspect of scientific inquiry was not understood enough, with 27.7% responses rated naive and 23.6% responses were mixed. That means participants' answers were not well organized to separate the specific reasons required in (a) from the generalizations in (b). Participants also could not fully understand what was meant by 'types' of information in question (b) because their answers were not meaningful. For example, one answer was "*If the feet and hands of the dinosaur can reach the floor, it cannot use the advantage of being tall (According to my hearings about nutrition). Being tall cannot be advantage. (It won't be special feature of being the tallest animal). The scientists don't go to conclusion just according to one* *thing. They also look different things such as different conditions, characteristics, adaptation in environment*" (Participant 41). Most answers referred to strong legs, balance and current knowledge about dinosaurs. On the other hand, just only few participants stated some information about fossils in their response.

4. Conclusions and Discussion

It is a fact that scientific literate citizens influence their country development and these countries lead the World's economy. Many societies' first aim became to educate generations that can research, investigate, question, criticize, solve the problems of their lives (Chin, 2005). Individuals learn to possess these competencies especially in science courses. So the importance of science courses increases day by day and the contents of these courses are constantly being renewed according to the needs of the age. By the reconstructing science concepts in science education, it became more complex and diffucult to teach scientific inquiry. In this regard, science teachers should develop informed views about scientific inquiry, and they should translate their informed views and understandings into science classes (Lederman, 2007). It is also important to note that science teachers' views of scientific inquiry may be enhanced through training they have received. In addition to this, it can be concluded that science teacher education programs have a mission to train science teachers to understand scientific inquiry properly. Therefore, science teacher education program has a main place in the implementation of curriculum reforms for science classes (Abd-El-Khalick, Bell, and Lederman, 1998; Solbes and Vilches, 1996). In the light of these concerns, Turkish pereservice science teachers' views of SI were the main focusof this study. As in many other countries, developing contemporary scientific inquiry views plays an important role of science education program in Turkey. Turkish science education program promotes field experiences, scientific literacy, and contemporary teaching methods to produce qualified teachers (*MEB*, 2004).

The goal of this study was to explore senior preservice science teachers' (PST) views about scientific inquiry. Data analysis revealed that most of the senior science teachers seemed to have naive view to all five aspects of the eigth aspects of SI. In other words, unfortunately, the many senior PSTs in the study did not have a clear understanding of what SI is. "*Scientific investigations all begin with a question*" was the least understood aspect of inquiry that many PST showed naive views. This lack of aspect means that senior PST were not well aware that investigations are based on questions. In other words many learners thought a question as an essential starting point. They also had misconseptions about scientific problem that they thought a scientist first decides to do an investigation and then goes to formulate the question. And most of the participants were not able to explain what an experiment was.

Many researches stated that one of the common misconceptions about the scientific inquiry is that both the students and teachers believed scientists use one single scientific method to do science (Abd-El-Khalick and Lederman, 2000; McComas, 1996; Windschitl, Thompson, and Braaten, 2008). As it is stated above, many senior PST had naive view on the second SI aspect. The findings of this research showed that all participants viewed science as unique and they thought that if the research is scientific everyone must follow one similar way. PST also indicated that all investigations were experimental and should follow a specific method. Unfortunately, the scientific method is taught at schools with a hierarchical relationship in Turkey just like many other countries, so that these findings are not suprising. Although epistemologists have generally agreed that there is no such hierarchical steps as scientific method, the chapter one of most science course books includes five-steps or seven-steps scientific method that describes how to do science (Ryan and Aikenhead, 1992). Because of teachers, course books, teaching methods and evaluation system, students have to memorize these steps of scientific method and they have to follow these steps when experimenting in science courses to succeed. The contemporary view of scientific inquiry advocated that there is no single fixed set or sequence of the steps that all scientific investigations follow. Scientific investigations begin with questions and these questions guide approaches. These approaches vary widely within and across the scientific disciplines and fields (Lederman, 2004).

This study results provide the information that senior science teachers have difficulties in understanding some other aspects of scientific inquiry, such as "*Research conclusions must be consistent with the data collected*", "*Scientific data are not the same as scientific evidence*" and "*Explanations are developed from a combination of collected data and what is already known*". Sadly, the results of the study stated that the majority of the senior science teachers have naive views on all of these aspects of scientific inquiry. On the other hand, the best understood aspect of SI by science teachers was that "*All scientists performing the same procedures may not get the same results*" demonstrated by an informed count. The second high informed count was for the third aspect: "*Inquiry procedures are guided by the question asked*".

Unfortunately, it is not possible to say that the program was successful under these circumstances regarding scientific inquiry. It is engrossing that the opinions of science teachers who have only one semester to graduate are not at the level of understanding scientific inquiry that is expected during the four-year program. Perhaps one of the reasons is that although science teachers in the science teacher training program take many different laboratory courses, they may not have the opportunity to think the components of the scientific inquiry. Perhaps, we, educators, do not give them enough time to improve their questioning abilities in scientific inquiry process or do not use the right methods and techniques to let them to construct their understandings about scientific inquiry.

This study includes important results in terms of the effects of the teacher training program and curriculum development. We need to study further on the effect of teacher education program on preservice science teachers' views about scientific inquiry. The current study is limited to a descriptive research. For a future study, researchers may work on the same students for four years; in this way, it is possible to mention the development of preservice science teachers' views of scientific inquiry during the four years' teacher training program. Furthermore, the same study can be designed by teacher educators.

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