EXPLORING THE RESEARCH ASSISTANTS' OPINIONS REGARDING THE EFFECTS OF GRADUATE COURSE ON THEIR RESEARCH SKILLS AND SCIENCE PERCEPTION

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE PROGRAM OF SCIENCE AND TECHNOLOGY POLICIES STUDIES

SEPTEMBER 2011

Approval of the Graduate School of Social Sciences

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

EXPLORING THE RESEARCH ASSISTANTS' OPINIONS REGARDING THE EFFECTS OF GRADUATE COURSE ON THEIR RESEARCH SKILLS AND SCIENCE PERCEPTION

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September 2011, 109 pages

The aim of this qualitative study was to explore research assistants' opinions regarding the courses they take during their graduate study in terms of improving their science perception and research skills.

The research questions include research assistants' assessments about the effectiveness of graduate courses on research skills and science perception, their evaluation of the graduate programs in terms of improving science perception, and their suggestions on the improvement of the quality of the graduate program regarding science perception and research skills.

The sample for the present study contains 12 interviewees from four different

institutes of Middle East Technical University. The interviewees are all PhD candidates at METU. The sample was chosen by using purposive sampling. In this study, the data collection instrument was a semi-structured interview guide designed by the researcher. There were 8 main questions and 9 sub-questions. The collected data was analyzed through content analysis.

The results of the study are presented under four main themes, which were derived from the research questions. First theme was the assessment of research skills which was about usefulness of courses, competence about research methods, reasons for not taking courses, problems because of not taking them. The second theme was the assessment of science perception which was about contributions of courses, reasons for not taking courses. The third theme was the evaluation of the graduate programs which consisted of *should-be-developed* and *positive* aspects. The last theme was about suggestions which could be realized by university administration and by personal efforts.

In conclusion, the findings revealed that the research assistants are aware of the importance of research methods course for enhancing research skills, and of effectiveness of history and philosophy of science course regarding the improving of science perception. In this respect, based on literature review and the research assistants' views it is suggested that history and philosophy of science course utilizing explicitly-reflective inquiry approach should be included curriculum of graduate programs.

Keywords: Nature of Science, Scientific Literacy, History of Science, Philosophy of Science, Science Perception, Research Skills

ÖZ

LİSANSÜSTÜ EĞİTİMİN ARAŞTIRMA BECERİLERİNE VE BİLİM ALGILARINA OLAN ETKİSİNE İLİŞKİN ARAŞTIRMA GÖREVLİLERİNİN GÖRÜŞLERİNİN İNCELENMESİ

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Eylül 2011, 109 sayfa

Bu nitel çalışmanın amacı, araştırma görevlilerinin lisansüstü programlarında aldıkları derslerin araştırma becerilerini ve bilim algılarını geliştirme açısından görüşlerini incelemektir.

Araştırma soruları; araştırma görevlilerinin lisansüstü eğitimini araştırma becerilerine ve bilim algısı üzerine olan etkisi hakkındaki fikirleri, bilim algısını geliştirmeye yönelik lisansüstü eğitimlerini genel olarak değerlendirmeleri ve araştırma becerilerini ve bilim algılarını geliştirmeye ilişkin üniversite tarafından neler yapılabileceğine ve kişisel çabaların ne olması gerektiğine yönelik önerileri içermektedir.

Bu araştırma örneklemi Orta Doğu Teknik Üniversitesi'nin dört ayrı

enstitüsünden 12 doktora derecesi adayını kapsamaktadır. Bu kişiler amaçlı örnekleme metodu ile seçilmiştir. Çalışmada, veri toplama aracı araştırmacı tarafından hazırlanmış 8 ana ve 9 alt sorudan oluşan yarı yapılandırılmış bir görüşme formudur. Toplanan veriler içerik analizi tekniği kullanılarak analiz edilmiştir.

Araştırmanın bulguları dört ana tema altında toplanmıştır. Bunlar araştırma becerilerine yönelik değerlendirmeler (derslerin faydası, araştırma metotları hakkında yetkinlik, dersleri almama nedenleri, ders almamaktan doğan problemler), bilim algısına yönelik değerlendirmeler (derslerin katkıları, dersleri almama nedenleri), lisansüstü programlarının *geliştirilmesi gereken* ve *olumlu* yönleri açısından genel değerlendirmeler ve üniversite ve kişisel çaba olarak neler yapılması konusunda öneriler.

Özetle, bulgular araştırma görevlilerinin araştırma metotları dersinin araştırma becerilerini arttırma açısından öneminin ve bilim tarihi ve felsefesi dersinin bilim algısını geliştirme yönünden etkililiğinin farkında olduğunu göstermektedir. Bu anlamda, literatür incelemesine ve araştırma görevlilerinin fikirlerine dayanarak açık-düşündürücü-araştırmacı yaklaşımların kullanıldığı bilim tarihi ve felsefesi derslerinin lisansüstü programların müfredatına dahil edilmesi önerilmektedir.

Anahtar Kelimeler: Bilimin Doğası, Bilim Okur-Yazarlığı, Bilim Tarihi, Bilim Felsefesi, Bilim Algısı, Araştırma Becerileri

To Fikriye and Nedim,
My Mom and Dad

ACKNOWLEDGEMENTS

I thank to my supervisor Prof. Dr. Soner Yıldırım, who guided me and encouraged me during my thesis. I thank to my co-advisor Dr. Tunç Medeni. He especially helped me while preparing interview questions. I am also really thankful to Dr. Göknur Kaplan, who helped me to improve my thesis.

I am indefinitely thankful to my friend İbrahim Tanrıkulu who unsparingly gave their interests and supports all the time and whose thoughts and views I benefitted from in great deal.

I would like to thank my dearest friend Ayşegül Özdemir who is always with me in my all happiness and troubles. Without her encouragement, support, help, and love everything in my life will be harder.

I am thankful my dear friend Ayten Dizkırıcı who gave me supports and encouragements.

I am thankful to my friend İdris Candan who always encouraged me and I drank his delicious tea in order to go on studying at midnights.

I am thankful to my dear friends Seda İşgüzar, Ebru Özbay, and Gülben Torğut for their supports and help from Elazığ. We are friends since high school and we lost nothing from our friendships, even it is being stronger year after year.

I would like to thank my dear friends Özge Eken, Kürşat Kurtar, Binnur Özkan, Nursel Yılmaz, Oğuz Öztürk, and Bülent Öztürk from campaign of OKULA YÜZ VERİN. They are my family in Ankara.

I am thankful to my dear friend Bahar Yılmaz who always gave me encouragements during my thesis. She is always beside in my all happiness and troubles.

I am thankful to my friends İbrahim Arpacı, and Nurcan Alkış who helped me at most urgent moment during completing thesis.

I am also thankful to my friend Özgür Şeker who was with me at my most hopeless moment during data collection.

I am grateful to committee members, Prof. Dr. Erkan Erdil, Göknur Kaplan Akıllı, and Assistant Professor Dr. Erdal Akdeve their suggestions and comments. Their valuable contribution helped me improve my work.

I am thankful to my all participants who were very helpful and they all sincerely answered my all questions without boring.

I am thankful to Prof. Dr. Gerhard-Wilhelm Weber who is firstly my German friend and, he helped me to improve grammar mistakes of my thesis.

I also thankful to Prof. Dr. Orhan Arslan who provided me to look future hopefully.

I am thankful to my head of department Prof. Dr. Erkan Erdil who always with us in every issues about our life. He is best director who I have ever seen in all my life.

I'm also thankful very much to my loves, my mother Fikriye Yasan, my father Nedim Yasan, my dear brother Mehmet Yasan, and my dear sisters Çiğdem Işık, Özlem Şengün, and Hilal Aydoğdu who are like my half-mother. I am really very luckily one since I have such a warmhearted family.

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ABBREVIATIONS

NOS: Nature of Science

HOS: History of Science

POS: Philosophy of Science

METU: Middle East Technical University

ÖYP/ FDP: Faculty Development Program

TEKPOL: Science and Technology Policies Studies

SI: Scientific Inquiry

CHAPTER I

INTRODUCTION

The introduction section reveals a justification of the issue by presenting background information about the study, the purpose of the study, the research questions, the significance of the study, and definition of the important terms. This section also covers the important terms used in the study.

1.1. Background of Study

The most important purpose of science education is the preparation of scientifically literate students (American Association for the Advancement of Science [AAAS], 1990). Moreover, having an adequate understanding of nature of science (NOS) is the central component of scientific literacy (Khalick, 1998; Klopfer, 1969; National Science Teachers Association [NSTA], 1982).

At this point, one of the important issues is how we can define these terms: scientific literacy and nature of science.

A consensus definition of scientific literacy has not been achieved, yet. This term stays as a vague term which is defined and interpreted in many different ways

(Zuzovsky, 1997). As defined by the American Association for the Advancement of Science (AAAS),

> *"scientifically literate person is one who is aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understands key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific ways of thinking for individuals and social purposes" (1990).*

A different definition was made by Bybee (1997): "understanding the concepts, principles, theories, and processes of science, the nature of science, and awareness of the complex relationships between science, technology, and society" (cited in Bell, 1999). Regarding these, in two definitions, understanding of nature of science and the relationship between science and society are the main characteristics of scientific literacy. In order to be defined as a scientifically literate person, s/he should use her/his scientific knowledge to make personal and societal decisions (Lederman, 1998). In this sense, it can be stated that scientific thought will help for developing better decision making skills.

The definition of the phrase "nature of science" has also not accepted by all philosophers of science, historians of science, and science educators. According to Lederman (1998), although many definitions were made, they were not relevant to K-12 instruction. Relevant to K-12 it refers to "the epistemology of science, science as a way of knowing, or the values and beliefs inherent to the development of

scientific knowledge" (Lederman, 1992). Moreover, some aspects of NOS can be generalized (Lederman, 1998). These aspects of NOS are explained by Schwartz, Lederman, and Crawford (2004, p. 613) and indicated in Table 1.1.

Table 1.1.

NOS Aspects and their Definitions

NOS Aspects	**Definitions**
Tentativeness	*Scientific knowledge is subject to change with new observations and with the reinterpretations of existing observations. All other aspects of NOS provide rationale for the tentativeness of scientific knowledge.*
Empirical basis	*Scientific knowledge is based on and/or derived from observations of the natural world.*
Subjectivity	*Science is influenced and driven by the presently accepted scientific theories and laws. The development of questions, investigations, and interpretations of data are filtered through the lens of current theory. This is an unavoidable subjectivity that allows science to progress and remain consistent, yet also contributes to change in science when previous evidence is examined*

Table 1.1. *continued.*

	from the perspective of new knowledge. Personal subjectivity is also unavoidable. Personal values, agendas, and prior experiences dictate what and how scientists conduct their work.
Creativity	*Scientific knowledge is created from human imaginations and logical reasoning. This creation is based on observations and inferences of the natural world.*
Socio-cultural embeddedness	*Science is a human endeavor and is influenced by the society and culture in which it is practiced. The values of the culture determine what and how science is conducted, interpreted, accepted, and utilized.*
Observation	*Science is based on both observation and inference. Observations are gathered through human senses or extensions of those senses. Inferences are interpretations of those observations. Perspectives of current science and the scientist guide both observations and inferences. Multiple perspectives contribute to valid multiple interpretations of observations.*

Table 1.1. *continued.*

Laws and Theories	*Theories and laws are different kinds of scientific knowledge. Laws describe relationships, observed or perceived, of phenomena in nature. Theories are inferred explanations for natural phenomena and mechanisms for relationships among natural phenomena. Hypotheses in science may lead to either theories or laws with the accumulation of substantial supporting evidence and acceptance in the scientific community. Theories and laws do not progress into one and another, in the hierarchical sense, for they are distinctly and functionally different types of knowledge.*

Source; Schwartz, Lederman, and Crawford, 2004, p.613

Even there is no consensus on characteristics of nature of science, McComas & Olson, 1998) extracted from eight international science standards documents showing a significant overlap (Table 1.2).

Table 1.2.

A Consensus View on the Nature of Science Objectives Extracted from Eight International Science Standards Documents

- *Scientific knowledge while durable has a tentative character.*
- *Scientific knowledge relies heavily, but not entirely, on observation, experimental evidence, rational arguments, and skepticism.*
- *There is no one way to do science (therefore, there is no universal step-by-step*
- *Science is an attempt to explain natural phenomena.*
- *Laws and theories serve different roles in science; therefore students should note that theories do not become laws even with additional evidence.*
- *People from all cultures contribute to science.*
- *New knowledge must be reported clearly and openly.*
- *Scientists require accurate record keeping, peer review and replicability.*
- *Observations are theory-laden.*
- *Scientists are creative.*
- *The history of science reveals both an evolutionary and revolutionary character.*
- *Science is part of social and cultural traditions.*
- *Science and technology impact each other.*
- *Scientific ideas are affected by their social and historical milieu.*

Source: McComas, Clough & Almazra, 1998, p.6.

Because of the great impact of science on cultural, economic, social and education life, many studies have been carried out to investigate science perception of citizens, teachers and students in recent years. The present study focuses on science perception of research assistants.

Results indicated that public, students and teachers did not have adequate NOS conceptions. Because of this, there have been some reforms to improve understanding of NOS aspects. In this sense, there are two distinct approaches to improve the NOS views in the recent literature: the implicit approach and the explicit-reflective approach. The new curriculum has mostly emphasized the fields of philosophy, sociology, and history of science and studies showed that it has a positive impact on understanding of NOS (Klalick&Lederman, 2000). Similarly, explicit reflective approach undertaken within science methods course is influencing NOS views in a positive way. In this study, research assistants' views regarding the courses they take during their graduate study in terms of improving their science perception and their research skills are investigated. Research assistants are the candidates of doctorate who completed their course load and in their dissertation and writing stage in the level of writing thesis and from different departments at Middle East Technical University. In order to develop a valid understanding of NOS at graduate programs, evaluation and suggestions of research assistants will be taken into consideration.

1.2. The Purpose of the Study

The main purpose of present study is to investigate the research assistants' opinions regarding the courses they take during their graduate study in terms of improving their science perception and their research skills.

The purposes of this study are:

- To identify research assistants' opinions regarding the effects of graduate courses on their research skills.
- To identify research assistants' opinions regarding the effects of graduate courses on their science perception.
- To identify how research assistants evaluate their METU graduate program in terms of improving their science perception.
- To identify research assistants' suggestions on the improvement of the quality of their graduate program in terms of science perception and research skills.
- To identify which courses or activities can be included METU graduate program to enhance science perception.

1.3. The Significance of the Study

This study is to explore the effectiveness of current METU graduate programs in terms of improvement science perception and research skills among METU research assistants. A general evaluation of graduate programs was done by research

assistants in terms of enhancing research skills and improving science perception. The present study inspired from a research which aimed to understand science perception of research assistants as early career academics. The research was conducted with 347 research assistant at METU. The results of the study presented that they had strong interest in their academic fields. At this point, the research aimed to explore the views of research assistants regarding the effects of graduate courses on their research skills and science perception. Firstly, how many research courses or similar courses are offered at graduate programs was investigated (see Appendix A).

By the present study, how to improve quality of graduate programs at METU will be explored and the results will help to make new policies.

According to the research, this study will help to improve the quality of graduate programs of Middle East Technical University in terms of research skills and science perception. Moreover, it will be an example for other universities of Turkey.

1.4. Definition of the Important Terms

In support of the research questions and literature review, the following definitions are utilized in the study:

1.4.1. Scientific Knowledge

Scientific knowledge refers to the products of science such as concepts, theories, and laws.

1.4.2. Scientific Thought

Scientific thought is to make correct predictions of events in nature (Walker, 1963).

1.4.3. Perception

The perception refers to “the process or result of becoming aware of object, relationship, and events by means of the senses, which includes such activities as recognizing, observing and discriminating” (American Psychological Association, 2007, p. 683).

1.4.4. Science Perception

It refers to understanding of nature of science and its aspects. Moreover, it includes having critical thinking ability and scientific thought.

1.4.5. Epistemology

It is the branch of philosophy concerned with the nature and scope (limitations) of knowledge; it is also called “the philosophy of science”.

CHAPTER II

LITERATURE REVIEW

This study focuses on research assistants' opinions regarding the courses they take during their graduate study in terms of improving their science perception and their research skills. The aim of this chapter is to give information about the review of relevant literature related to *nature of science* and *scientific literacy*, methods for improving perception of NOS labeled *implicit approach* and *explicit approach* respectively.

2.1. Nature of Science and Scientific Literacy

In the second half of the twentieth century many research has been conducted about nature of science (NOS). It is important because major science educators put it the center of scientific literacy. Scientifically literate person refers to understanding of concepts, principles, theories, and processes of science, and the person who realize the complex relationships among science, technology, and society (Khlalick, 1998). Moreover, adequate understanding of the nature of science is one of the characteristics of scientifically literate person. Consequently, "a scientifically

literature person should be able to apply the aforementioned knowledge and understanding of science to decisions concerning science-related personal and societal issues" (Klopfer, 1969; NSTA, 1982; cited in Khalick, 1998).

Lederman (1992) cited in his article 'adequate understanding of the nature of science' or/and understanding of 'science as a way of knowing' is becoming as aim of science instruction (American Association for the Advancement of Science, 1989; Hazen & Trefil, 1991; Rutherford & Ahlgren, 1990). As mentioned previous section, there is a lack of consensus definition of the phrase "nature of science". The reason of this lack of consensus is not about the complexity of scientific endeavor. It is because of development of science and systematic thinking about science so that the phrase "nature of science" has had different definition during past 100 years (cited in Khalick, 1998; AAAS, 1990, 1993; California Department of Education, 1990; Center of United Science Education at Ohio State University, 1974; Central Association for Science and Mathematics Teachers, 1907; Klopfer & Watson, 1957; NSTA, 1982).

The phrase "nature of science" generally refers to issues such as "what science is, how it works, the epistemological and ontological foundations of science, how scientists operate as a social group and how society itself both influences and reacts to scientific endeavors" (Clough, 2006). However, there are some certain aspects of NOS which are tentativeness, empirical basis, subjectivity, creativity, socio-cultural

embeddeness, observation and inference, and laws and theories (Khishfe & Lederman, 2007).

According to the AAAS (1990) there are three basic components of an adequate understanding of the NOS (cited in Khalick, 1998). The first component is carrying the world as understandable, and viewing that there are many questions not answered yet. The second one is about the nature of scientific inquiry. Besides being logic and empirically based, inquiry in science also includes imagination and the invention of explanations. The last component is the understanding of the social and political aspects of science.

Deniz (2000) handled importance of adequate understanding of NOS on three grounds: curricular, democratic, and pedagogical. Curricular argument is about having a general background for scientifically-based knowledge and it is connected to the democratic argument. The democratic argument claims that in the future students should be scientifically literate citizens in order to make right decisions about controversial issues in science, which is an essential requirement for being a democratic society. For the pedagogical argument, having an adequate understanding of NOS can provide the learning of a certain science content.

2.2. Teaching Methods for Nature of Science

According to Khalick (1998), generally there are two attempts to improve conceptions of NOS. First approach is labeled *explicit* approach, utilizing from history and philosophy of science (Akindehin, 1988; Billeh & Hassan, 1975; Carey

& Stauss, 1968, 1970; Jones, 1969; Lavach, 1969; Ogunniyi, 1983) ; the second approach is labeled implicit approach, utilizing science process skills instruction and/or scientific inquiry activities (Barufaldi et al., 1977; Riley, 1979; Trembath, 1972) or manipulated certain aspects of the learning environment (Haukoos & Penick, 1983, 1985; Scharmann, 1990; Scharmann & Harris, 1992; Spears & Zollman, 1977). However, there is not a certain distinction between explicit and implicit approaches. It is about providing conceptual framework such as aspects of NOS. Although history of science (HOS) is labeled explicit approach, it can be thought as implicit approach if aspects of NOS are not mentioned directly. Similarly, scientific inquiry can be explicit approach if explicates aspects of NOS. However, it should not be understood that explicitly teaching the NOS is the only issue for accurate NOS conceptions. Designing lessons to address particular NOS issues and also reflectively teaching the NOS that help students make connections between activities and targeted NOS issues are equally important (Lederman, 1998). Moreover, research also supports that giving both explicit and reflective approach is more effective in NOS instruction (Clough, 2006; Khalick, 1998).

Moreover, results of studies indicated that explicit approach utilizing elements from history and philosophy of science (HOS) might be more effective that implicit approach in enhancing conceptions of NOS (Khalick, 1998). During the past 80 years, science educators (e.g., Conant, 1947; Monk & Osborne, 1997; Rutherford, 1964; Wandersee, 1992; Abimbola, 1983; Brush, 1969, 1989; Duschl, 1989; King, 1991; Klopfer & Watson, 1957; Matthews, 1994; O'brien & Korth, 1991;

Robbinson, 1969; Rutherford, 1964; Scheffler, 1973) have repeatedly advocated that HOS has a significant role in developing appropriate conceptions of scientific endeavor (Khalick, 1998). In this case, the concept of the HOS deals with epistemology of scientific knowledge and its development. According to Sarton (1952, p. 59) "HOS can be used to explain the meaning of science, its function, its methods, its logical, psychological and social implications" (Khalick, 1998).

2.2.1. The Implicit Approach to Improve NOS Views

There are 3 studies in this section. The following four studies investigate the effect of students' research experiences on their perceptions of NOS.

According to the study of Ritchie and Rugano (1996) where they discussed the viability of cognitive apprenticeship for learning science in school in relation to findings from an investigation of a research project involving high school students working in a university chemical engineering laboratory under the mentorship of university-based scientist. Two secondary school students at the age of 11 and 12 from Australia were selected for the study. They were both serious about a scientific career and both were successful in their science and mathematics classes. They stated that all laboratory sessions were observed by a researcher who constructed field notes which focused on context, discursive interactions and the participants' actions. The primary source of data was gathered from the researcher's notes. Also, researchers prepared and conducted interviews by the help of the field note. The researchers found three major assertions after analyzing the data. The first one was

concerned with the development of students in lab techniques and conceptual understanding. The second assertion was difficulties provided opportunities to practice skills, but increased frustrations and revived memories of fudging in school cookbook labs. The last assertion was students developed into independent researchers during the project. Besides all these results, the researchers indicated that the students did not have adequate views of nature of science at the end of the program.

Richmond and Kurth (1999) investigated how research apprenticeships shaped students' views of the culture and practice of science. They tried to answer two questions; what is it that is compelling to young apprentices about the dimensions of scientific culture and practice, and how does it influence their learning? Where does this learning take place, i.e., what communities are available to them and what resources do they offer? They used a qualitative ethnographic approach in all phases of the investigation. Twenty-seven 11th and 12th graders from across the United States and American Samoa were interviewed. Results of the data analysis revealed four dimensions of the culture and practice of science. The four dimensions include technical language, collaboration, uncertainty, and inquiry. Using the dimensions uncovered in this study as guidelines, they suggested several opportunities to help students develop insights concerning scientific practice. First, they suggest structuring investigations to let the students problematize data collection and analysis. Second, they orchestrate work in order to distribute expertise across group members. Third, they use scaffolding to support construction by scientific

terminology. Fourth, they engage students in longer-term connected investigations to correlate information learned in earlier phases and the sense-making tasks they undertake later. The results of the study indicated that there were remarkable changes in students' understanding of NOS at the end of only a 7-week experience.

Bell, Blair, Crawford, and Lederman (2003) performed a study which aimed to interpret the effect of an 8-week science apprenticeship program on students' understandings of the nature of science and scientific inquiry. The study was applied 10 high-ability secondary students (6 females, 4 males) from grades 10-11 enrolled as apprentices at a Northwest University. Before and after the apprenticeship a modified version of the Views of Nature of Science, Form B (VNOS-B) was applied to students in order to evaluate students' views about the NOS and scientific inquiry. Moreover, a semi-structured interview was made with students, which provided students opportunities to evaluate their apprenticeship and give details about their responses to the VNOS-B.

All four researchers analyzed the students' responses to questionnaire and interview transcribes. Before the analyze three identical sample was chosen. The all researchers compared the results which were similar more than 95 %. Moreover, they categorized the views of students' understanding of NOS and scientific inquiry before and after the apprenticeship experience.

In the apprenticeship, specific process skills and aspects of experimental design were generally given students. Little time was spent on aspects of NOS explicitly.

According to the results, the students indicated little change in the students' understanding of NOS and none of the students had an adequate understanding of NOS at the end of the apprenticeship. Moreover, the students increased their level of experience on doing science, but few ones only showed development in the understanding of nature of scientific inquiry.

In summary, Ritchie and Rigano (1996) and Bel et al. (2003) reported that students' perception of NOS did not change without mentioning implicitly aspects of NOS. Conversely, the study of Richmond and Kurth (1999) indicated thatimplicit approach may be successful to develop adequate understanding of NOS.

2.2.2. The Explicit - Reflective Approach to Improve NOS Views

This section includes 10 studies which aimed to investigate the impact of explicit-reflective NOS approach on students' understanding of NOS.

In order to be effective in enhancing learners' conception of NOS, according to Klopfer (1969): "adequate time should be allowed for discussion so that the subtle understanding in the historical narrative may be fully developed" (p.63) (cited in Khalick, 1998). In the same way, Russell (1981) argues that "if we wish to use the history of science to influence students' understanding of science, we must … treat [historical] material in ways which illuminate particular characteristic of science" (cited in Khalick, 1998). It is obvious that content of HOS has an important role to improve NOS views, especially elaborating aspects of NOS in explicit attention.

One of the earlier studies was conducted by Klopfer & Cooley (1963; cited in Lederman, 1998) who developed a curriculum called "History of Science Cases for High Schools" (HOSC) (cited in Lederman, 1992). The materials derived from history of science and the curriculum would give important ideas about science and scientists. The study was applied on 108 geographically representative science classes, including biology, chemistry and physics (2, 808 students). In order to assess effectiveness of the HOSC curriculum, the most widely used paper-and pencil type instrument called the Test on Understanding Science (TOUS) instrument which is a four-alternative sixty item multiple choice test was developed in 1961 by Klopfer & Cooley, was used. After a five month treatment period, students receiving HOSC curriculum indicated significantly greater gains on the TOUS than the control groups. The results also affected across disciplines in a positive way. Moreover, the students were more successful on the TOUS subscales (i.e., the scientific enterprise, the scientists, and the methods and aims of science) like on the overall test. It was concluded that the HOSC curriculum was an effective way in order to develop students' conception of the NOS.

Similarly, using the TOUS instrument Jones (1965) compared the effectiveness of a curriculum like HOSC with a traditional physic science course at the college level (cited in Lederman, 1992). While traditional course gave attention to vocabulary, results of discoveries, factual level information, quantitative procedures, and problem solving; the experimental course which is the general education approach to physical science emphasized also historical development, philosophy of

science, and the interaction of science and society to a greater degree. He found that the general education approach to physical science was more effective than the traditional approach in terms of enhancing students' understanding of the NOS.

A comprehensive study about effects of various curriculums on students' understanding of the NOS was conducted by Yager and Wick (1966) by TOUS instrument (cited in Lederman, 1992). There were three approaches all of which revolved around the Biological Sciences Curriculum Study (BSCS) Blue Version. The first approach was the Textbook-Laboratory (TL) utilized text books and laboratory materials. The second one was the Multi-Referenced Laboratory (MRL) approach utilized materials from the TL group as well as additional paperbacks, texts, references, and passages from original scientific works. The last approach was the Multi-Referenced Laboratory and Ideas (MRLI) was alike MRL group, but differently, the historical development of the major concepts and principles in science was exposed. The effects of teacher variation were controlled for all three groups. The results indicated that MRLI group's students had largest gains on the TOUS, then MRL group placed second and TL group exhibited the smallest gains.

One of the important studies was performed by Akerson, Abd-El Khalick, and Lederman (2000). They aimed to assess the effect of explicit- reflective and activity-based approach on pre-service teachers' views of seven aspects of NOS. There were 50 participants in the study. This group consisted of 25 undergraduate students (23 females and 2 males) and 25 graduate students (22 females and 3 males). The

subjects were enrolled in two sections of the investigated course which was specially designed elementary science methods course. The students had similar science background and were in the first year of their respective programs.

Both sections of the science method course were taught by the same instructor who was the first author. The requirements and structure of two sections were similar, which same reading, activities and assignments were given. Especially in first week of class, participants were undertaken in specially designed activities that were coupled with explicit NOS instruction. During the whole of the remainder of the course, participants were provided with structured opportunities to reflect on their views of the target NOS aspects. Activities related to NOS aspects were explicitly given and subjects were supported relating science content and pedagogy to NOS aspects.

An open-ended questionnaire and semi-structured interviews were applied together to evaluate students' views of the target aspects of NOS. Questionnaire was applied to all students before and after the course. For interviewing 40 participants were chosen (20 from each course). In each course section, 10 participants were randomly selected at the beginning and the other of students at the end of the course. The aim of these interviews was to collect more detailed information about students' views of NOS and to make clear misunderstandings of open-ended questionnaire. While the interviews were performed by the first author; the data analysis was

performed by second and third author separately for the validity of NOS questionnaire.

The results of the study indicated that most of participants held insufficient views of the target NOS aspects at the beginning of the course. Furthermore, undergraduate and graduate students' views of the target aspects were not indicated difference substantially. At the conclusion of the course most students held adequate views of NOS in both groups. However, there was not a consistency among the gains of aspects of NOS. While students had more gains in aspects of NOS such as tentativeness, creative and imagination, observation and inference, theories and laws; they had fewer gains in theory-laden and socio-cultural NOS aspects. In conclusion, the study indicated that the explicit-reflective NOS instruction was effective way to improve pre-service elementary teachers' views of NOS.

A similar study was conducted by Schwartz, Lederman, and Crawford (2002). The aim of the study was to assess the effect of science research internship course on pre-service secondary science teachers' development of NOS conception. There were 13 participants (seven males and six females) who were secondary pre-service science teachers enrolled in a fifth-year, Master of Arts in Teaching (MAT) teacher preparation program in a mid-sized, Western University. The course comprehended authentic scientific inquiry experiences, explicit NOS instruction, and guided reflections. A formal NOS questionnaire (VNOS-C) with semi-structured interviews

was applied to participants before and after the research course. This course had three basic components which were seminars, journals and research setting.

Each participant had a responsible practicing scientist at the University. Moreover, all attempts were made according to interns' educational background and teaching interests. The course was for 10 weeks and all interns spent regular 5 hours a week in the research settings. The students were asked to engage with a project in order to gain authentic research skills. For five 2- hour seminar interns were able to discuss research settings and experiences, make connections between their research experiences and science teaching. Journals included two sections which were research and reflection. The opportunities were provided interns to keep detailed records much like a practicing scientist and to develop connections between research experiences and NOS aspects. Each participant was analyzed separately and compared with the other participants' profiles.

The results indicated that eleven of 13 participants enhanced their NOS views. Only 2 participants did not demonstrate any progress in their NOS views. Moreover, interns stated that research experiences did not directly affect their NOS views. However, they accepted that the research experiences helped to create a context for reflections on NOS aspects. It was also reported that research experience had little impact on understanding of NOS. The study showed that the explicit-reflective NOS approach enhanced preservice teachers' understanding of NOS.

An early study was conducted by Deniz (2007). He examined the effectiveness of explicit-reflective instruction on preservice elementary teachers' NOS views and epistemological views. The sample consisted of 161 (148 female, 13 male) preservice elementary teachers enrolled in an introductory science course. The science course focused on three major themes which were science process skills, hypothesis testing, and the NOS. In the first theme, NOS aspects were taught using the context of explicit-reflective NOS instruction for 4 weeks. In the hypothesis testing part, inquiry oriented lessons were given students for 4 weeks. In the last theme, the students were asked to participate in "Rutherford's Enlarged" (Abd-El-Khalick, 2002) activity and to prepare a presentation about the history of the atomic theory. Moreover, various readings assigned to students about the science education community's perspective on NOS aspects.

The results of the study showed that the explicit-reflective NOS instruction was effective in developing epistemological beliefs and NOS views. Moreover, findings indicated that there was a correlation between previous epistemological beliefs and NOS views and post-instruction epistemological beliefs and NOS views.

A study was conducted by Crumb (1965) who compared the Physical Science Study Curriculum (PSSC) to traditional high school physics by using TOUS instrument (cited in Lederman, 1992). Unlike the traditional approach, PSSC is a laboratory centered and emphasizing process not only science content. The sample

was applied to 1, 275 students from 29 high schools. The results indicated that PSSC students had greater gains than students received traditional physics curriculum.

Gess-Newsome (2002) performed a study which aimed to find effects of the explicit-reflective NOS and science inquiry instruction on perceptions of science in a science method course. The sample consisted of 30 preservice teachers (28 female and 2 male) enrolled in the science method course. All participants were in their senior year and previously engaged in other science content courses and pedagogical courses.

The course was for 2 hours, twice a week, during ten weeks. It focused on three main goals: to enhance students' understandings about science content, the NOS, and SI; to equip students with experiences in inquiry-based approach; to help students design and implementation of inquiry based science instruction.

The results of the study indicated that the explicit-reflective NOS approach developed elementary preservice teachers' views about NOS and scientific inquiry. Moreover, the science method course enhanced preservice science teachers' understanding of NOS and scientific inquiry.

Another study was conducted by Abell, Martini, and George (2001), which was about NOS, scientific inquiry, and scientific process skills. The purpose of the study was to investigate which teaching methods are effective to enhance students' understanding of NOS views. The science methods course was given future elementary teachers for six-week period at the beginning of the semester.

The sample consisted of 11 forthcoming elementary teachers. Researchers especially focused on four aspects of NOS: (1) scientific knowledge is empirically based, (2) subjective (theory-laden), (3) partly the product of human inference, imagination, and creativity, (4) socially embedded. Students were asked to write a reflection about related aspects of NOS every week. A final reflection about investigation and ideas related to instruction was also one of the requirements of the course. Moreover, the second author made interview with students. The interview aimed to investigate especially students' beliefs about science teaching and learning, and NOS understanding. Data analysis was made by all three researchers and common patterns were found. During the analyze phase, the references were aspects of NOS described by Abd-El-Khalick et al. (1998) and the National Science Education Standards (1996).

At the end of the study, researchers realized that they did not taught science explicitly. The students were not assisted to generate direct connections between science learning activities and NOS aspects. In other words, although researchers intended to be explicit at the beginning of the course, they behaved implicitly about teaching NOS aspects. According to the results, the researchers provided some recommendation about explicit NOS approach for future studies.

Another earlier stud was performed by Özgelen (2010). The purpose of the study was to investigate the effects of the explicit-reflective and inquiry based laboratory instruction on preservice science teachers' understanding of NOS aspects. The

sample consists of 45 preservice science teachers (34 female, 11 male) who were enrolled in the Laboratory Application in Science 2 course offered by the faculty of education. The participants were juniors and their science backgrounds were similar. The course was taught in two different sections. The course hours were the same for all sections, which was 4 hours. The organization of weekly course activities was presented Table 2.1.

Table 2.1.

Organization of Weekly Course Activities

Week	Time	Content
1	*15-20 minutes*	*Quiz, related to laboratory activities and the aspect of Nature of Science*
	2 hours	*Laboratory activities related to the aspects of Nature of Science*
	1 hour	*Presentation and discussion about results of activities and relationship nature of science aspect.*
	30 minutes	*Reflection paper, related to laboratory activities and the aspect of Nature of Science*

Source: Özgelen (2010)

As seen in Table 2.1, the main themes of the course were NOS aspects, explicit-reflective instruction, dimension of effective teaching of NOS, teaching NOS through inquiry, and science process skills.

According to the results, explicit-reflective and inquiry based laboratory instruction developed the preservice science teachers' views about NOS. In addition, the findings showed that there were three factors affecting preservice science teachers' understanding of NOS. These factors were discussion and presentations, using inquiry skills, and doing inquiry-based laboratory activities.

To sum up, the above studies aimed to identify accurate approach for improving students' conceptions of the NOS. According to results, the explicit-reflective approach is more suitable to develop adequate understanding of the NOS.

The review of studies from science education literature indicated that the most important component of scientific literacy is adequate understanding of NOS. In this sense, many studies conducted in order to help students to develop accurate NOS views. The studies showed that a more suitable method for changing students' NOS views is the explicit-reflective approach. Moreover, scientific inquiry instruction impacts positively students' understanding of NOS. Finally, the present study has aimed to reveal research assistants' views regarding the courses they take during their graduate study in terms of improving their science perception and their research skills.

CHAPTER III

RESEARCH METHODOLOGY

In this chapter, the method of inquiry was described in detail. This chapter describes the design of the study, participants, instruments, data collection and analysis processes, assumptions and limitations.

3.1. Problem Statement of the Study

3.1.1. Research Question

The main problem is to investigate research assistants' opinions regarding the courses they take during their graduate study in terms of improving their science perception and their research skills.

3.1.2. Sub-Questions

In this qualitative study, specific questions are indicated below:

Question 1: What are research assistants' opinions regarding the effects of graduate courses on their research skills?

Question 2: What are research assistants' opinions regarding the effects of graduate program on their science perception?

Question 3: How do research assistants evaluate the METU graduate program in terms of improving their science perception?

Question 4: What are research assistants' suggestions on the improvement of the quality for their graduate program in terms of science perception and research skills?

3.2. Overall Design of the Study

The aim of this study is to investigate METU research assistants' opinions regarding the courses they take doing their graduate study in terms of improving their science perception and their research skills.

In order to carry out the present study's purpose, a qualitative research design was used. This method is especially useful for determination to understand a phenomenon in real life settings. Qualitative research method aims to get an in-depth understanding of human behavior and the reasons causing such behavior. Moreover, researchers used this method when to emphasize discovery rather than validation and confirmation (Selvikavak, 2002; Krathwohl, 1998). When the data of the study are based on the personal knowledge and experiences of the subjects, this method is applied. As Campbell (1996) said the researcher aims to investigate participants'

view and is personally involved in the process of data gathering. Although there are many different types of qualitative methodologies, it has some general characteristics. Bogdan and Biklen (as cited in Fraenkel & Wallen, 2005, p.430-431) describe five aspects of qualitative research method, as indicated below:

1. *The natural setting is the direct source of data, and the researcher is the key instrument in qualitative research.*
2. *Qualitative data are collected in the form of words or pictures rather than numbers.*
3. *Qualitative researchers are concerned with process as well as product.*
4. *Qualitative researchers tend to analyze their data inductively.*
5. *How people make sense out of their lives is a major concern to qualitative researchers.*

There are three main techniques to collect data in qualitative research method: observing people, conducting in-depth interviews with people and analyzing documents. In this study researcher used interviewing technique which is the most important data collection technique (Fraenkel & Wallen, 2005; Fetterman, 1989). This technique provides us to find out what is on people's mind and what they think or how they feel and how they develop the perspectives they hold (Bogdan & Biklen, 1992). There are three types of interviews: structured, semi structured, and retrospective. In this study, semi-structured was chosen as a method for collecting

data, this method is one of the most useful type of interview for obtaining information to analyze a specific hypothesis that the researcher has in mind (Fraenkel & Wallen, 2005, p.455). In order to get in-depth answers from the subject and to be able to have a systematic control over the question this type is more suitable for the present study.

3.3. Participants

The study involves research assistants from Middle East Technical University which is one the most well-known and scientifically recognized university in Turkey. The campus of Ankara has five graduate schools which are 'Natural and Applied Sciences', 'Social Sciences', 'Informatics', 'Applied Mathematics', and 'Marine Sciences'. The data collected from research assistants who belong to these graduate schools except Graduate schools of Marine Sciences because it is not on the Ankara campus. Moreover, the number of research assistants was determined according to the density of graduate schools' research assistants' population. The distribution of research assistants to their departments and graduate schools are indicated in Table 3.3.1.

Table 3.3.1.

The Distribution of Participants According to Their Graduate Schools

Participants	Departments	Graduate Schools
1.	Biological Sciences	Natural and Applied Sciences **(5)** **35.7 %**
2.	Physics	
3.	Electric-Electronic Engineer	
4.	Computer Engineer	
5.	Chemistry	
6.	Science & Technology Policies S.	Social Sciences **(4)** **29.4 %**
7.	Science & Technology Policies S.	
8.	Educational Science	
9.	Psychology	
10.	Information Systems	Informatics **(2)** **21.6 %**
11.	Information Systems	
12.	Mathematics	Applied Mathematics **(1)** **%13**

In many cases, as the present study, purposive sampling is used in order to contact with 'knowledgeable people', i.e. "those who have in-depth knowledge about particular issues, may be by virtue of their professional role, power, access to

networks, expertise or experience (Cohen, Lawrence & Morrison, 2007; Ball, 1990). Thus, in this study the most appropriate sampling strategy is non-probabilistic – the most common of which is purposive or purposeful sampling (Top, 2007; Patton, 1990).

In purposive sampling, the researcher's own judgment was the essential. However, the researcher also was a research assistants and she had some experiences with her colleagues. She observed that the research assistants criticized their graduate programs in terms of improving science perception. Moreover, the researcher specified some criteria with the help of her supervisor. Considering of these observations, the researcher's main criterion was to be a candidate in a doctorate program and having completed all courses offered their graduate programs. Moreover, these research assistants started to write their dissertations. It was wanted to learn which problems they were experiencing, whether they were able to use their knowledge on their research or not, and whether they perceived any lack of knowledge or not. This specific group was chosen in order to get overall an evaluation about their graduate program.

3.4. Data Collection Instruments

In this study, the data collection instrument has been a semi-structured interview guide designed by the researcher. This type of interview is rather formal and

comprises a series of questions designed to obtain specific answers (Fraenkel & Wallen, 2005, p.455).

What is more, during the data analysis a research can use three main data collection techniques which are interviews, observations and, artifact and documents analysis (cited in Kaplan, 2004; Yin, 1994; Merriam, 1998). Using of these three techniques provides triangulation of the data. However, the researcher used only interviews. Although the other two techniques, which are observations and, artifact and documents analysis, were not used, Reigeluth and Frick(1999) stated that " the interviews are the most valuable data gathering instruments, which allows the researcher to explore the participants' perspective, reactions and thinking in-depth with probes and to discover the possible improvements for the case." (cited in Kaplan, 2004).In order to build the interview process, several steps were undertaken. Firstly, graduate schools of METU were analyzed in terms of how many research methods course or similar courses are offered. Secondly, a wide literature related to improvement of science perception was reviewed. Then, the research questions and interviews were analyzed as a model. Finally, the pilot study was conducted to be sure which interview questions are meaningful and appropriate regarding to the research questions, and to the questions of which were working properly or not. The pilot interview was carried out with two professors in the field of education and science & technology policies studies, three research assistants, one graduate student, one linguist, one instructor and one associate professor who studied similar subject in his thesis concerned with understanding of nature of science.

After the pilot study, the researcher needed to make some necessary changes according to participants' critiques in the pilot testing: understandable and with a simple use of language, elimination of the questions unrelated with the research questions, yes-no type of questions, and addition of some questions to obtain precise answers.

The interview guide has two main sections (see Appendix B). The first section aims to collect demographics and educational field. The second section consists of 8 main questions and 9 sub-questions. Basically, these questions are sorted into four main sections which are "assessment of graduate programs in terms of enhancing research skills", in the same way "assessment of graduate programs in terms of improving science perception", "general evaluation of graduate programs", and "suggestions for improving of the quality of graduate programs" .

3.5. Data Collection Procedures

The data were collected from research assistants of Middle East Technical University (METU) in Ankara. All participants acknowledged the aim of the study before starting interviews. During the interviews, a tape recorder was used with permissions of participants. The names of participants and their interviews were kept. All the interviewees volunteered and were interested in the study. The lengths of the interviews changed between 20 minutes to 35 minutes.

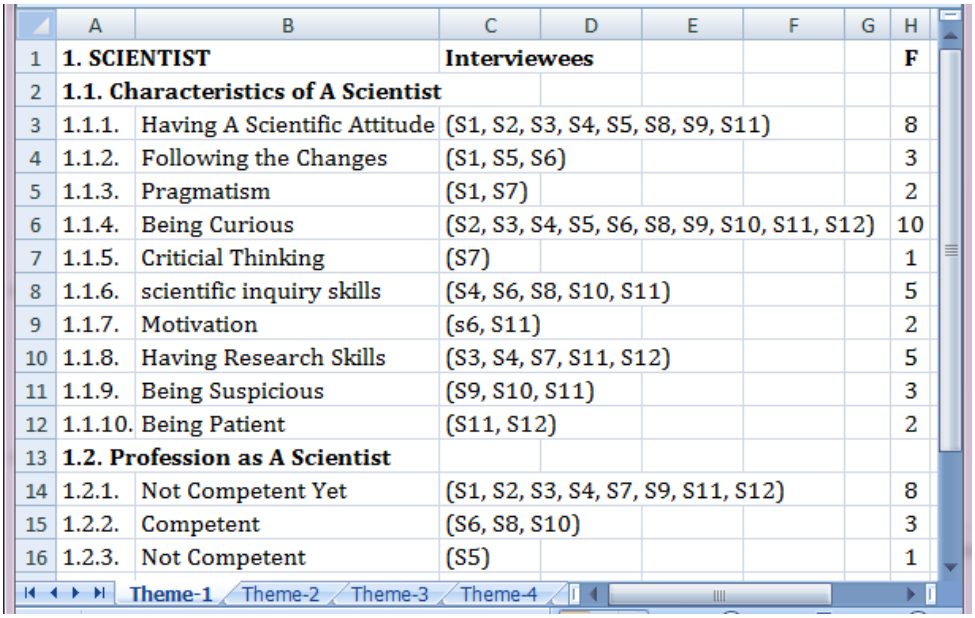
3.6. Data Analysis Procedures

Analyzing a qualitative data is often difficult by their interpretation, and there are many interpretations methods. The most important principle is *fitness for purposes*, in other words, the researcher must know what she/he wants the data analysis to do (Cohen, Lawrence & Morrison, 2007). Moreover, the key element of qualitative analysis is data reduction, which can be commonly done by content analysis referring "many words of texts are classified into much fewer categories" (Cohen, Lawrence & Morrison, 2007; Weber, 1990: 15).

In this study, for the analysis the following steps were pursued: Firstly, the interviewees were numbered and the transcriptions of recorded interviews were conducted. The transcriptions were carefully read many times by the researcher. Content analysis started with coding by using categories that emerged as data was reviewed. Then, the determined codes and their frequencies were listed. Thus, the number of specific incidents was found in data. Moreover, the researcher realized that one participant did not express his ideas clearly because of not understanding operational definition of science perception. She made an interview again with this participant by taking notes. Similarly, some participants did not explicitly answer some questions. The researcher dealt with this problem by personal verbal communications and e-mails.

Lastly, MS Excel was used to organize the identified patterns, categories and their sub categories (see Figure 1). For each research question a spread sheet was

opened and for every theme, identified categories and their sub-categories were noted in separate columns (see Appendix E). Next to each, the number of interviewees who identified that category was noted and the frequencies were noted.



	A	B	C	D	E	F	G	H
1	**1. SCIENTIST**		**Interviewees**					**F**
2	**1.1. Characteristics of A Scientist**							
3	1.1.1.	Having A Scientific Attitude	(S1, S2, S3, S4, S5, S8, S9, S11)					8
4	1.1.2.	Following the Changes	(S1, S5, S6)					3
5	1.1.3.	Pragmatism	(S1, S7)					2
6	1.1.4.	Being Curious	(S2, S3, S4, S5, S6, S8, S9, S10, S11, S12)					10
7	1.1.5.	Criticial Thinking	(S7)					1
8	1.1.6.	scientific inquiry skills	(S4, S6, S8, S10, S11)					5
9	1.1.7.	Motivation	(s6, S11)					2
10	1.1.8.	Having Research Skills	(S3, S4, S7, S11, S12)					5
11	1.1.9.	Being Suspicious	(S9, S10, S11)					3
12	1.1.10.	Being Patient	(S11, S12)					2
13	**1.2. Profession as A Scientist**							
14	1.2.1.	Not Competent Yet	(S1, S2, S3, S4, S7, S9, S11, S12)					8
15	1.2.2.	Competent	(S6, S8, S10)					3
16	1.2.3.	Not Competent	(S5)					1

Theme-1 Theme-2 Theme-3 Theme-4

Figure 1. *Sample data analysis*

3.7. Assumptions and Limitations

The assumptions and limitations encountered during this study are stated as below.

3.7.1. Assumptions

The followings are assumed for the present study:

- Participants were not affected by any circumstances.
- The participants honestly and sincerely replied the all questions.

3.7.2. Limitations

In the present study, the qualitative approach is used. There were 12 participants who were selected by using purposive sampling which has lack of generalizability. Thus, this study cannot be generalized to any larger populations.

Related with the methodology of the study, the validity and reliability of the study will be limited. In this study, interviews are used as the data source. Thus, problems of honesty, time constraints of the interviewees may be limitations for the study.

CHAPTER IV

FINDINGS

The purpose of the study was to indicate research assistants' views regarding the courses they take during their graduate study in terms of improving their science perception and their research skills. The opinions of research assistants studying METU graduate programs as a PhD candidate were investigated by a semi-structured interview schedule. The research questions of the study were:

1- What are research assistants' opinions regarding the effects of graduate courses on their research skills?

2- What are research assistants' opinions regarding the effects of graduate courses on their science perception?

3- How do research assistants evaluate the METU graduate program in terms of improving their science perception?

4- What are the research assistants' suggestions on the improvement of the quality of their graduate program in terms of science perception?

The sample consisted of 6 female and 6 male research assistants who were studying in Middle East Technical University and from different graduate schools. The research assistants belongedto graduate schools of Natural Sciences (n = 5), Social Sciences (n = 4), Informatics Institutes (n = 2), and Applied Math (n = 1).

Qualitative analyses were carried out in the study. The following 4 themes were found: (1) Opinions regarding the effects of graduate courses on research skills, (2) Opinions regarding the effects of graduate courses on science perception, (3) Evaluation of the graduate programs in terms of improving science perception, (4) Suggestions on the improvement of the quality of graduate programs in terms of science perception and research skills. These four main themes and sub-themes are explained below.

4.1. Research Skills

What are the research assistants' opinions regarding the effects of graduate courses on their research skills?

Courses/Seminars/Activities. The participants were asked to list the courses, seminars or activities which they attended during their METU graduate program that they think have been helpful to enhance their research skills. While 6 of the participants attended, the other 6 participants did not take any courses during their

graduate program. Moreover, none of the participants involved any seminars or activities in terms of enhancing research skills.

The other interview questions divided two groups according to the courses *taken* or *not taken*.

The research assistants who attended the courses were indicated with the courses' names and codes in Table 4.1.

Table 4.1.

Codes and Names of the Courses Attended by the Research Assistants

Research Assistants	**Course Code**	**Course Name**	**The Department which the course was given**
S3	8310605	Research Methods and Analytical Techniques	Science and Technology Policies Studies
S4	2360595	Boundary Element Methods	Mathematics
	2360688	Finite Element Methods	Mathematics
S7	4200520	Research Methods in Education	Secondary Science & Mathematics Education
	4100601	Advanced Research Methods	Elementary Education
	5200621	Research Methods Education	Science & Mathematics
S8	2320507	Research Methods	Sociology
	2330500	Research Methods	Psychology

Table 4.1. *continued.*

	8310605	Research Methods	Science and Technology Policies Studies
S10	9010720	Research Methods in Information System	Informatics Institutes
S12	2330500	Research Methods	Psychology
	2330113	Research Methods	Psychology
	2330610	Advanced Research Methods	Psychology

Advantages of Courses/Seminars/Activities. The opinions of the research assistants were asked about the usefulness of the courses which they took during their graduate program. All the research assistants (n = 6), who attended to courses, indicated that these courses were effective regarding their academic development. The participants (n = 5) especially stated that the research methods courses were very useful, very important, and the main course for them. All participants (n = 6) said that they learnt different research methods by these courses. At the beginning of the interview, the researcher asked the participants which characteristics a scientist should have (Table 4.2). Five of them responded that a scientist should have research skills. In the light of this information, it can be said that the participants realize the importance of having research skills.

Table 4.2.

Characteristics of a Scientist According to the Research Assistants

Characteristics of A Scientist	**Frequencies**
Having Scientific Attitude	8
Following the changes	3
Pragmatism	2
Being curious	10
Critical thinking	1
Querying skills	5
Motivation	2
Having research skills	5
Being suspicious	3
Being patient	2

Research assistants (n = 3) stated that the research methods courses helped while writing thesis. A research assistant said:

"After I attended the research methods course, I noticed all my mistakes which I did in my master thesis. If I took this course before my master thesis, it would be more accurate and more realistic. However, I will apply my knowledge about research methods in my doctoral dissertation. Therefore, I can say that I am sad because I attended the course after I wrote my master's thesis, but I am happy because of taking it before my doctoral dissertation … I think that this course was more effective than the other all courses which I took in my graduate program."

In the same way, a research assistant stated that this course facilitated her/his dissertation and said:

"I mean, when a hypothesis is given to you or when an idea is suggested, it helped in terms of making operational definition, correlation of variables, and decision which analyses can be applied at the end of correlation."

A participant stated that these courses provided saving him/her time and made an explanation:

"If I did not attend any research methods courses, it would extend the time … You are preparing a thesis. You maybe learn from the rough by yourself and of course you would be able to learn again but you would extend the time."

A participant stated that this course epistemological and methodological contributed his/her academic attitude and commented:

"As a researcher conducting more qualitative studies this course helped me to perform quantitative studies."

Only one of them, who had attended three research methods courses from different departments, found them inadequate in terms of teaching "asking question". She said that:

> *"The research methods course was useful but insufficient. Although we learnt different research methods, we are still incapable of 'asking question'. I mean it is insufficient in giving the epistemological dimension."*

She stated that one of the main problems of such courses was the focusing only quantitative methods, but the epistemological dimension was also very important. She explained the reasons as below:

> *"…I mean that the philosophy of study is not known. Such as 'What is scientific research? How does it perform? What is the point of output?' Since that perspective is not given, the person cannot find the right questions during their master and doctorate degrees. There is a big problem in this sense."*

All advantages of courses/ seminars/ activities are indicated in Table 4.3.

Table 4.3.

Research Assistants' Opinions About Advantages of C/ S/ E

Advantages of Courses/Seminars/Activities	**Frequency**
The courses helped while writing thesis.	3
The courses contributed regarding epistemological and methodological attitude.	1
I learnt different research methods.	6
Saving of time	1

Competence about Research Methods. Another question is to what extent the research assistants think themselves competence about research methods. Three different answers were given. Four research assistants said that even if their knowledge was imperfect they had notable level. One of the participants explained it as follows:

> *"However, I am basically aware of the epistemological arguments. In other words, when a certain research method is chosen, I will be able to consider its epistemological and ontological dimensions. I mean I think I can realize it."*

Another research assistant, who felt not capable yet, commented:

"I am not sufficient and at the beginner level. I have learnt its basics yet. I will develop it."

A research assistant felt capable himself about research methods and said that:

"I have research skills and I know how I should search something. Moreover, it is safe to say that I have the best conditions in Turkey in this sense."

Only one of the research assistants thought that she was not capable and addressed:

"Although I achieve to find solutions about the problem and know that the techniques of research methods I am not capable of because 'asking question' is not taught."

The research assistants (n = 6), who did not attend any courses or who did not participate any seminars and activities, were asked three different questions.

Reasons of not Taking Courses/ Seminars/ Activities. First question was about the reasons because of not taking such research methods courses. The big majority of the participants (n = 5) explained that there were not any courses like research methods in their departments. Only one participant was not aware of such courses. In addition, four of the research assistants stated that if there was a course about research methods, they would absolutely want to attend. On the other hand, two of them said that if there was, they would consider. The research assistant, who was unaware, commented:

"Although there was a research methods course in my department, I would not take it since I am not aware of insufficiency of my knowledge about research methods."

Table 4.4 showed the research assistants' reasons of not taking such any research methods course with the frequencies.

Table 4.4.

The Research Assistants' Responses About the Reasons of not Taking such any Courses

Reasons of not Taking Courses/ Seminars/ Activities	**Frequency**
There were not any courses in our departments.	5
If there was a course, I would absolutely take.	4
If there was a course, I would consider.	1
If there was a course, I would not take.	1
There was not such a course or I do not know.	1

Usefulness of Courses/ Seminars/ Activities. The second question aimed to investigate opinions of research assistants about the contributions of these courses in terms of improving research skills. All research assistants except one (n = 5) stated that these courses would be very useful and it would facilitate their studies. Two

participants said that they would learn research methods and techniques. One of the participant commented:

> "*When I was at undergraduate program, I took a course about how a research is conducted. Some subjects were given and some directions were given in that course. I mean, at least we were guided about how the basic research methods can be. However, I do not know what the advanced research methods are. If they were taught to us, it would be easy than learning them by ourselves."*

Three research assistants pointed out saving of time. In order to learn different research methods, they endeavored to learn by themselves. They had to look into many studies to model them. Because of that, they made more efforts and reasoned to take more time.

On the other hand, three of the research assistants do not have any information about research methods courses. They wanted to learn the content of course. After researcher's brief explanation, two of them found it useful and remembered some problems which they experienced at past because of not knowing research methods.

The viewpoints of the participants about usefulness of courses/ seminars/ activities were showed with the frequencies in Table 4.5.

Table 4.5.

Usefulness of C/ S/ A from the Viewpoints of the Research Assistants.

Usefulness of Courses/ Seminars/ Activities	**Frequency**
I would learn research methods/ techniques.	2
It would be very useful and facilitate to our studies.	4
Saving of time	3
Not have any information about the research methods course.	3

Problems Because of not Taking. The last question was whether the research assistants have faced any problems because of not taking any research methods course. Only two of the participants said that they did not experience any problems. One of the assistants said that s/he learnt with her/his efforts. The course would facilitate my work but I did not experience any problems. The other research assistants said:

> *"I did not experience any problems about searching. However, if I attended such a course, I do not know whether the works would facilitate or progress faster. I am not sure about it since I did not attend any courses."*

Four of the research assistants had experienced some problems about academic issues. Two research assistants mentioned about the difficulty of searching since they did not know research techniques. One of them described:

"I did not know how will I search? What will I write and where will I write? Learning them took a long time"

A research assistant did not have any information about the content of the courses. However, he made a suggestion which was all about research methods course.

"Our study area indicated difference from social sciences. the solution for problem A, which I developed or for problem B will be different. Talking for a general solution is not possible in the department of electrical and electronics engineering ... However, there could be a course like that: if I said I did not feel any incapability, it is a lie. I mean how can you review literature or how can you categorize the articles or papers or how should you categorize or whether you should categorize or not? Because sometimes you need such a categorization and sometimes you do not. The efforts that you make could be assessed as unnecessary. I learnt this by trial and error. To illustrate, we occasionally do some works for companies and we need to do literature review. We need to recognize whether the things which they want us to do have done before or not, and if we have done them how many new solutions there are and how successful these solutions became. This process took time. I mean, I reviewed literature, I did wrong. It was needed to look from a wider perspective. Unfortunately, I did not realize that before."

A research assistant maintained that another problem occurred while writing the thesis. In addition, four of the research assistants mentioned about loss of time. A research assistant also said that it caused loss of work as well as loss of time, and explained this as below:

"I mean to be able to understand the way you are losing a serious time. The students who did not take this course are starting three steps back, which are really great steps. Because you try to perceive. After the perception, the work is speedily going on. The water is flowing but finding that water is taking a lot of time…This means there will be loss of time as well as loss of work as I observed."

A research assistant said that some questions about her studies were still unknown and explained:

"You cannot know whether your studies are about science or not. Again you cannot know whether the questions you asked are scientific or how much scientific? You cannot know what your contribution is."

Table 4.6 revealed the all responses of the participants about their problems because of not taking the research methods course.

Table 4.6.

The Problems of Research Assistants because of not Taking the Research Methods Course.

Problems Because of not Taking	**Frequency**
I do not know the research methods/ techniques.	2
Loss of time	4
Loss of work	1

Table 4.6. *continued.*

While writing thesis	1
It does not make a sense for my studies.	1
I did not experience any problems.	2

4.2. Science Perception

What are research assistants' opinions regarding the effects of graduate courses on their science perception?

Courses/ Seminars/ Activities. The second question was about the science perception. Firstly, the participants were asked to list the courses, seminars or activities which they attended during their METU graduate program that they think have been helpful to develop their science perception. None of research assistants attended any courses. In this sense, only one research assistant who took course of the History of Science & Technology from Science and Technology Policies Studies during her master's program. Moreover, three of them stated that they have personal efforts such as making some readings about philosophy of science, and attending lectures at other universities. The general table of responses is stated below.

Table 4.7.

Codes and Names of the Courses Attended by the Research Assistants

Courses/ Seminars/ Activities	**Frequency**
I did not take such a course.	11
I did not take but I have personal efforts	4
I attended History of Science & Technology course from the department of Science & Technology Policies Studies.	1

Contributions of Courses/ Seminars/ Activities. The second question aimed of exploring the contributions of these courses (such as History of Science and Philosophy of Science) or activities on their science perception. In other words, how the research assistants think about the effects of the courses in terms of improving science perception. This question was categorized in three groups which are awareness, developing scientific attitude, and ignorance.

The majority (n = 10) though that these courses provided awareness. In this respect, two of them said that such courses opened new perspectives and gave directions to their studies. A research assistant commented:

> *"Who has contributed to the point where I am at? Or, if I want to do something, how can I start? We can answer such questions by these courses."*

In addition, the research assistants (n = 4) stated that these courses enhance the motivation and curiosity. According to the participants being curious (n = 10) and having motivation (n = 2) are the characteristics of a scientist (see Table 4.2). Therefore, it is obvious that the research assistants think that such courses have an important role to be able to be a good scientist. A research assistant gave an example from the teacher of one of her courses:

> *"We have a teacher who is living in America for a long time. He comes to give lecture at summer school time. Before starting lesson, he talks about history of science and he goes on like that 'Science is an idea!'. He informs about philosophers' ideas like Descartes. He tries to give their perspectives. Of course, the lecture does not finish in its normal time. This all is not about software but he tries to give us that perspective, which provides us with curiosity and awareness."*

A participant made a similar comment about the impact of the course on curiosity and motivation:

> *"For example, I already query the subjects which I am interested and want to search. Perhaps, if I had a developed scientific perception at first, my curiosity would be deeper or it would provide different perspectives."*

Related to the awareness, research assistants (n = 4) said that these courses provided querying skills which were also accepted as a characteristic of scientist by research assistants (n = 5) (Table 4.2). They commented that such courses answered the questions of whether I am doing science or what I am doing. A research assistant

explained the importance of philosophy of science or history of science as stated below:

> *"It is like building a construction without laying its foundation. It is necessary to be able to answer the question of what we are doing."*

In the same way, a researcher commented:

> *"If the main points of science are known, the things will be clearer and will be understood in depth."*

The other contributions are under the title of developing a scientific attitude. Firstly, having a scientific attitude was declared as a characteristic of scientist by eight of the research assistants (Table 4.2). While exploring the effects of such courses, six of the participants maintained that such courses help to develop a scientific attitude. In the light of this information, it can be said that these courses exhibit a significant role in order to be a competent scientist.

A research assistant showed the philosophy of science as an essential course and commented:

> *"After making some readings about philosophy of science, the things which I learned became clearer… After the doctorate program, we will not be only masters of our study areas, but also we will be philosophy of doctorate."*

A research assistant thought that the course of History of Science (HOS) had a significant place in scientific attitude and explained:

"History of science is one of the essential courses to make sense of my occupation because you can detect the plot of your study through history of science. Yes, the history of science is a long pathway, and perhaps your study is a very small pace. However, that step is very significant to make sense of your study. At least you must have an idea about history of your study because it will assign the point which you reach ... What is the purpose of your research? How do you analyze the research? Where do you want to reach? In order to make these questions sensible, I think that we need the history of science."

Two of the research assistants said that these courses encourage to search and enhance the discovery attitude.

Six of the participants commented that such courses helped to have more accurate steps and to be more successful.

A research assistant expressed three contributions in terms of: (1) learning of inquiry and formal logic, (2) improving of analytical skills, and (3) learning of different epistemological–methodological dimensions.

One participant thought that if these courses were given to students, they would be more successful in other lessons too.

At the end of the interview, one participant declared that even this interview gave him/her a different point of view. The phrase "science perception" turns into a concrete term from being discrete term for him/her.

On the other hand, two research assistants did not have any ideas about the contributions of these courses because of being ignorant about content of the courses.

Only one research assistant attended the History of Science and Technology (HOST) course as mentioned above. She said that the HOST course was about historical development of science and technology and it was far away philosophy of science. She found the course insufficient because:

> *"The current structure is so discipliner, which requires to improvement of science perception only in its disciplinary frame. However, I think that in order to have a complete science perception, I mean, scientific thought, it should be assessed with many different aspects.*

The detailed contributions of courses/ seminars/ activities were given in Table 4.8.

Table 4.8.

Research Assistants' Opinions About the Contributions of C/ S/ A

Contributions of Courses/ Seminars/ Activities	**Frequency**
Awareness	*10*
C/S/E open new perspectives and give directions.	5
C/S/E enhance curiosity and motivation.	4
C/S/E respond the questions of whether my study is science.	4

Table 4.8. *continued.*

Developing Scientific Attitude	*6*
C/S/E encourages to search and enhance the discovery attitude.	3
You have more accurate steps and become more successful.	6
Ignorance	*2*
I have no idea about the content of course and its contributions.	2

Reasons of not Taking Courses/ Seminars/ Activities. The last question about science perception is what the reasons are for not taking any of these courses. Except one all research assistants said that there were not any courses in their department. Ten of them stated that if there was a course like that they would want to attend or would consider. One of them said that even if there was such a course, she would not because of no interest with philosophy of science. There was only one research assistant who said that there were such a course but I did not interest because the methods of such courses were boring for her. She went on

> *"The instructor giving the lecture is very boring. Up to me, the course is very traditional and very disciplinar."*

4.3. Evaluation

How do research assistants evaluate the METU graduate program in terms of improving their science perception?

Should-be-developed. In the third question, the researcher wanted the participants to evaluate the METU graduate program in terms of improving their science perception. The research assistants though that some points should be developed. It can be categorized like that: lack of courses, work overload because of other academic responsibilities, problems about instructors, and significance.

Firstly, eight of research assistants talked about the lack of courses. Four of them stated the there were not any research methods courses in their departments. Seven of them maintained that there were not any courses aiming to develop science perception such as History of Science and Philosophy of Science.

On the other hand, some research assistants (n = 3) complained about the number of courses which were in their responsibilities, and the doctoral proficiency exam. A research assistant said that all these serious responsibilities reasoned to get ahead of the consideration of developing science perception. In the same way, a research assistant made an explanation:

> *"There is a prepared package whether it is related to your expertise or not but the program forces you to take it. This system confines you in a certain form."*

The other problem is about instructors. Three research assistants noted that instructors were not sufficient in terms of enhancing science perception. In other words, they do not direct students on this way.

Lastly, four research assistants stated that there is lack of significance of their studies. A research assistant explained:

> *"It is realized that History of Science and Philosophy of Science courses are needed. A student who is in a master's program cannot answer the question of what I am doing. Seven courses are totally taken but they are disconnected with each other. At the point of creating a general vision it is weak."*

A research assistant commented that the graduate programs are insufficient to teach 'asking right question'. Another research assistant made an explanation:

> *"The technical side of graduate programs is adequate but the essential point is inadequate. For example, you can know how an article can be written. Or every article has introduction, methodology, results, and discussion section and you can also know how every section is assessed. Or you can understand what you read and produce certain ideas. Hypothesizing is also included in your skills. Nevertheless, the essential point, which is querying, is not achieved in this department."*

The ideas of research assistants about the aspects of university which should be enhanced are indicated in Table 4.9.

Table 4.9.

According to the Research Assistants the Aspects of University should be Developed

Evaluation/ Should-be-developed	**Frequency**
There are not research methods courses.	4
There are not any courses to improve science perception such as HOS&POS.	7
Over-work of other academic responsibilities.	3
The point of making sense of our studies is inadequate.	3
The courses are disconnected to each other.	1
It is inadequate regarding ‘asking right question”.	1
The instructors are inadequate regarding to improving science perception.	3

Positives. Some research assistants found METU graduate program very effective regarding the developing research skills and improving science perception. Four research assistants indicated that the graduate programs are very successful in terms of enhancing research skills. One research assistant commented:

> *“Every university has good and bad aspects. However, to me the most important aspect of this university is teaching research.”*

In the same way, another research assistant talked about the contributions of METU graduate programs to his academic attitude.

> *"By now the most considerable positive aspect which was contributed by my academical studies is how I approach to a problem, how I solve the problem, how I gain the different perspectives about the problem, and how I do research with these different perspectives and develop a solution methodology."*

A research assistant assessed METU graduate program within Turkey standards and said that METU's own atmosphere was more suitable for querying and the students' profile regarding their skills was beyondTurkey's standards.

4.4. Suggestions

What are the research assistants' suggestions on the improvement of the quality of their graduate program in terms of science perception?

In the last question, the research assistants made suggestions on the improvement of the quality of their graduate program in terms of science perception. The suggestions were handled in two groups: (1) what can be done by your university? (2) What do you do (personal efforts)?

By University. When asking the research assistants what can be done by the university or department to improve their science perception of science, the big majority (n = 11) of them suggested a course such as Philosophy of Science (POS)

and History of Science (HOS). A research assistant said that the current system pushed students to memorizing and went on:

> *If the universities and the departments honestly add the philosophy in their curriculum, scientists will have an idea not only about their expertise but also other different ideas. This approach provides the scientist with producing new ideas instead of memorizing.*

A research assistant suggested POS/ HOS courses as well as Research Methods courses. While six research assistants supported that these courses should be given as a must course, two of them advocated that they can be elective. One of the research assistants said that such courses should be must after the qualification exam and gave an example:

> *"It can be a course like Teacher in Higher Education (which is given to all ÖYP research assistants as a must course after the qualification exam). After the qualification exam, there should be a must course. If I took Teacher in Higher Education before the qualification, I could not be interested in it much. I mean, it would be like a forced labor to me. However, it is more effective when most of the responsibilities are over. After a while you feel that you need some knowledge in this respect."*

However, four of them expressed that such courses should be given in undergraduate level. Another controversy issue is about seminars. On one hand five research assistants maintained that seminars may be effective regarding the improvement of science perception, on the other hand two of them thought that they were not. A research assistant expressed that the university should organize seminars

where important topics published by considerable journals were discussed. Moreover, another research assistant emphasized about routinizing of seminars.

Two research assistants advocated that universities should be free. A research assistant made a comment:

> *"Instead of a formal course, the university should endeavor to create environments where students can search well and think freely. In other words, the university should provide us with an environment where every question can be asked freely."*

Three research assistant maintained the importance of the instructors, and one of them said:

> *"It is much related to instructors who should improve himself/herself in this respect and should have interdisciplinary perspectives."*

Some research assistants (n = 3) had criticized overload of work caused by the other the academic responsibilities in evaluation section. In the same way, these research assistants suggested to reduce the responsibilities.

A research assistant made a general evaluation and offered some recommendations:

> *"In Turkey, we are educated in universities like in high schools and in graduate programs like in universities. I think that this chain must be broken. For instance, classes include about 30 students in graduate programs at METU. According to me, this is a terrible situation because there is no interaction and the students do not produce new ideas. The instructor comes*

to class, talks about the subject, after a while he makes exam, then the project finishes and whole matter is over. I mean that we should reach a point at which ideas are discussed. We should altogether produce original ideas, which are accurate method for learning."

Unlike others, one research assistant did not make any suggestion because of being satisfied about his graduate program.

The research assistants' suggestions for improvement of METU graduate programs are indicated in Table 4.10.

Table 4.10.

The Suggestions of the Research Assistants to University/ Department for Improvement of Science Perception.

Suggestions/ By University	**Frequency**
There should be courses such as HOS/ POS.	11
There should be courses for enhancing research skills.	1
HOS/POS should be given at undergraduate level.	4
HOS/POS should be a must course	6
HOS/POS should not be a must course.	2
HOS/POS should be a must course after doctorate qualification exam.	1
There should be seminars.	5

Table 4.10. *continued.*

The seminars may not be effective in this respect.	2
There should be a free searching environment.	2
The instructors should be educated in this sense.	5
The responsibilities should be reduced.	3
I am pleased with my graduate programs.	1

Personal Efforts. After the research assistants' suggestions, their personal efforts were asked regarding the improving their science perception. Firstly, whether the research assistants could describe their profession as a scientist or not, was investigated. While three of them considered competent themselves, one research assistant did not consider sufficient himself/ herself. Furthermore, eight research assistants said that they were not competent yet but they were about to be. In this respect, Table 4.11 demonstrates research assistants' opinions with the frequencies.

Table 4.11.

Responses to the Question of whether the Research Assistants could Describe their Profession as A Scientist or not.

Profession as A Scientist	**Frequencies**
Not competent yet	8
Competent	3
Not competent	1

The responses were summarized under four groups which are focusing on the nature of science (NOS), searching, scientific activities, and doing my job.

Nine of the research assistants said that focusing on NOS was one way for enhancing science perception. In this respect, they read books about philosophy of science or history of science. One of them read especially about philosophy of education because of its relation to her study area.

According to some research assistants (n = 7), searching in their study areas or reviewer current literature was also useful. In this respect, three research assistants indicated *following the changes* was one of the characteristics of a scientist (see Table 4.2).

Six research assistants talked about some scientific activities which were such as following scientific web sites (n = 1), watching scientific TV channels (i.e., Discovery Channel) (n = 3), observing (n = 1), organizing seminars (n = 1), creating environments with interaction (n = 1).

Besides all these activities, three research assistants stated that doing their job already enhanced their science perception.

A research assistant explained how a person can improve his/her science perception as follows:

> *"I believe that science perception will be improved by reading, equipping his/herself as well as sharing his/her knowledge with others. With equipping himself/herself I mean that attending courses or seminars. Furthermore, by the point of sharing I mean an environment where the ideas are being discussed and presented."*

Table 4.12 illustrates the research assistants' personal efforts for improvement of the science perception.

Table 4.12.

The Personal Efforts of the Research Assistants for Improvement of Science Perception

Suggestions/ Personal Efforts	**Frequency**
Doing research	3
Making reading about HOS/POS	9
Following literature	6
Following scientific web sites	1
My job improves my science perception.	2
Discovery channel enhances the motivation.	3
Creating environment with interaction	1
Organizing seminars	1
Observing	1

4.4.1. A Possible Course

The research assistants were asked if there was a possible course to improve his/her science perception, what s/he would suggest to include in its content, method, and evaluation.

Content. When asked about the content, the big majority of research assistants wanted the course to be about History of Science (n = 8) and Philosophy of Science (n = 7). A research assistant stated that essential points in history of science should be mentioned and it should change according to the departments. Another research assistant recommended telling life stories of worthy scientists in the history. Moreover, the research assistants (n = 8) thought that the course should answer the questions of what science is, what the aspects of science are, what the philosophy of science is.

The other research made different suggestions for content: the logic (n = 1), and scientific changes (n = 1). Three of them noted teaching 'asking right questions.' Furthermore, two research assistants stated that the content should be interdisciplinary, and they went on:

> *"While we produce new ideas in our fields, other areas are only a question mark for us. I mean that the perspectives which we do not think and do not see are in those fields or vice versa. Noticing different approaches in different fields can prevent from that blindness."*

Unlike the aforementioned suggestions, one of the research assistants recommended that literary works and life of artists or writers who had come into prominence with their creativity in the art and literature fields should be mentioned (i.e., Shakespeare).

Only one of the research assistants did not make any suggestions because of not being sure about its usefulness and he commented:

"I still have doubts about whether such courses are useful or not. Which courses should be for improving science perception? In fact I do not have much knowledge about it, and I cannot answer anymore."

Table 4.13 displayed the research assistants' suggestions for content of the possible course.

Table 4.13.

The Recommendations of Research Assistants About Content of the Possible Course

Possible Course/ Content	**Frequency**
History of Science	8
What is Science? & About Philosophy of Science	7
Logic	1
It should mention the changes in science & technology.	1
Teaching "asking right question" & Critical Thinking	3
It should be interdisciplinary.	2
Life or work of precious litterateurs	1
I am not sure about the usefulness of such courses.	1

Method. The general answer about the method of course was its novelty. The research assistants (n = 11) stated that this course should offer a sociable

environment and it should stay away classical course format. Six of them said that there should be a special student-teacher interaction and students can easily express their ideas. A research assistant gave an example:

> *"For example, there should be a round table that people can talk and discuss with each other face to face."*

Different materials were mentioned by research assistants (n = 7). Six of them said that readings were must. Nonetheless, five of them stated that readings were not enough and it should be supported with audio-visual materials in order to make it more sociable. The research assistants (n = 5) again mentioned about the importance of instructors.

The research assistant who suggested literary works for content made a different recommendation for method too. He said:

> *"A part should be chosen from the writers' (who are famous for their creativeness in art and literature fields) books or dramas, and a theater performance for 20-25 minutes should be played out of the classroom."*

Table 4.14 demonstrates the research assistants' suggestions for methodology of the possible course.

Table 4.14.

The Recommendations of Research Assistants About the Method of the Possible Course

Possible Course/ Method	**Frequency**
Audio & Visual Materials	5
Readings	6
It should be far away standard lecture format.	11
The instructor is important.	1
There should be interaction.	6

Evaluation. All research assistants except one (n = 11) stated that there should not be an examination. In other words, there should not be grade anxiety. However, instead of exams the research assistants offered different suggestions which included proposals, project presentations, homeworks, and different activities. One research assistant emphasized that attendance should be must and should affect grades because she believed that students did not attend regularly without an obligation.

Only one research assistant said that there may be an exam in order to learn better.

Table 4.15 displays the research assistants' suggestions for evaluation of the possible course.

Table 4.15.

The Recommendations of Research Assistants About Evaluation of the Possible Course

Possible Course/ Evaluation	**Frequency**
There should be no exams.	6
Exam can be done.	1
Proposals can be offered.	2
There should be no grade anxiety.	10
There can be project presentations.	1
Attendance should be a must and should affect the grades.	1
There can be homework.	1
Different activities.	2

CHAPTER V

DISCUSSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The aim of the present study was to answer the question of what the research assistants' opinions are regarding the courses they take during their graduate study in terms of improving their science perception and their research skills. From the data obtained, there were four main themes in the study: research skills, science perception, evaluation, and suggestions.

This chapter presents the findings, implications derived from the study, and recommendations for further studies.

5.1. Discussions

5.1.1. Research Skills

What are the research assistants' opinions regarding the effects of graduate courses on their research skills?

The findings of the study indicated that research methods course was found effective on the improvement of research skills by participants. Regardless of

attending the course, participants mentioned various contributions these courses made to their epistemological and methodological attitudes. Similarly, Khalick and Akerson's study revealed that a science methods course had a positive impact on epistemological development. In the same way, the study of Sandoval (2003) indicated that inquiry was using as a method to understand the views of NOS in recent science reforms. Moreover, several advantages were expressed such as helping during writing thesis, saving of time, facilitating other studies. At the same time, they stated that having research skills was one of the characteristics of scientist. Similarly, Lederman et al. (2002) stated that "scientists observe, compare, measure, test, speculate, hypothesize, create ideas and conceptual tools, and construct theories and explanations." Thus, being competent on research methods was major qualification for their profession. The research assistants attending the course felt themselves competent about the basic issues of research methods and they believed that they would be able to achieve some progress in that sense. The research assistants who did not take any research courses emphasized some problems they lived because of not taking any courses. They said that it caused especially loss of time and loss of work since they did not know any research techniques or methods. Furthermore, they faced problems while making sense to their studies. Most of the research assistants emphasized that there was a lack of such research methods courses at graduate programs of METU. They suggested that these courses should be included into the curriculum. However, a few research assistants did not have any information about research methods courses. Therefore, they could not make any

comments about its usefulness and necessities. They thought that all courses they were attending at graduate level were helpful to improve research skills. In addition, some of research assistants claimed that METU had better conditions then other universities in this respect.

5.1.2. Science Perception

What are research assistants' opinions regarding the effects of graduate courses on their science perception?

None of the research assistants except on attend to a graduate course that aims to improve science perception. They did not take such courses because their departments did not have any courses such as history of science and philosophy of science. Only one of them took History of Science and Technology as a must course from her department of Science & Technology Studies. The big majority found these courses effective in improving their science perception so that they would be willing to take such courses. This view was supported by research in which it was reported that HOSC instructional approach had a big impact on improvement of students' science perception (cited in Lederman, 1992; Klopfer & Cooley, 1963; Jones, 1965, Crumb, 1965; Ramy & House, 1969, Yeger & Wick, 1966; Aikenhead, 1979). The research assistants commented that the things became clearer and deeper when they found out the nature of science. The literature also supports this view which knowledge of the nature of science helped to students in learning science content

(McComas et al., 1998). In the same way, research supports that philosophy of science course improved the science perception of pupils (cited in Lederman, 1992; Kimbalk, 1968; Cary & Staus, 1968). On the other hand, some studies indicated that there was no significant difference among students whether they took the course or not regarding the conception of science (cited in Lederman, 1992; Trent, 1965; Troxel, 1968; Jungwirth, 1970; Tamir, 1972; Durke, 1974). While evaluating graduate programs of METU, they assessed a *lack of these courses* as one of the "*should be developed"* dimensions. They especially expressed the importance of these courses regarding the awareness and the development of scientific attitude. For awareness, the contributions of such courses were opening new perspectives and giving new directions, enhancing curiosity and motivation, querying of his/her profession. They also assessed their profession as a scientist. Thus, it can be said that such courses had a significant place in the graduate studies for the research assistants. As for the development of scientific attitude, most of research assistants thought that such courses encouraged them to search and enhanced their discovery attitude. They believed that they had more accurate steps in their studies. The big majority suggested HOS and POS as a must course. Some universities like state of Florida have such curriculum which required prospective science teachers to take the history and philosophy of science (McComas, 1998). In order to emphasize the importance of the courses, some research assistants suggested that these courses should be given at undergraduate level. However, there were also a few research assistants who did not have any ideas about these courses.

5.1. 3. Evaluation

How do research assistants evaluate the METU graduate program in terms of improving their science perception?

When the research assistants were asked to evaluate their graduate programs of METU in terms of improving their science perception, the responses were generally similar to each other. Lack of courses such as research methods, history of science, and philosophy of science were indicated by most of them. The participants evaluated that the current courses were insufficient regarding the teaching to ask right questions, and making sense of their profession. They also complained about over-work of other academic responsibilities. Furthermore, instructors were found inadequate in terms of improving science perception. On the other hand, some research assistants stated that all courses of METU were effective on improving research skills and science perception.

5.1.4. Suggestions

What are the research assistants' suggestions on the improvement of the quality of their graduate program in terms of science perception?

According to the findings of the study, METU graduate programs should focus on HOS, POS, and research methods courses which were believed to be very effective on the improvement of science perception by most of the research

assistants. Many studies also support that coursework in the history of science is an effective way to enhance teachers' conceptions toward science (Khalick et al., 1998; Duschl, 1990; Haywood, 1927; Klopfer 1964, 1969; Akerson et al., 2000; Khalick, 2001; Khishfe & Khalick, 2002). If there was a possible course to improve science perception, the suggestions of research assistants were asked in detail. What the content, method and evaluation of a possible course should be, was the question. For content, as mentioned above, the course of history and philosophy of science was suggested. Related to this idea, Micheal Martin's (1972) book *'Concepts of Science Education: A Philosophical Analysis'* maintained that "philosophy of science clarified teachers' thought about nature of science and helped them understand the roles and methods which guide study in the discipline." (McComas et al., 1998). The general view about the main point of the content was to be an answer the question of what science was. Moreover, the content of the possible course was to aim at teaching 'asking right question' and 'critical thinking'. Suggestions for the method were also similar to each other, which was "the novelty." The research assistants thought that the possible course should be different from classic lecture format. In this new format, interaction was the essential requirement. Importance of the instructors was also mentioned again. Related to this, literature also supports that teachers have a direct impact on effectiveness of courses (Khalick et al., 1998). Moreover, Jungwirth (1970) concluded that achievements of students in this area could be developed through 'redirected teacher effort and emphases' (cited in

Lederman, 1992). The opinions of the research assistants were alike with Lederman (1992) who stated:

> *"In general, the classes of the most effective teachers were typified by frequent inquiry-oriented questioning, active participation by students in problem-solving activities, frequent inquiry-questioning, active participation by students independent seat work, and little emphasis on memory/recall. With respect to classroom climate, classes of the more effective teachers were more supportive, pleasant, and 'risk free' with students expected to think analytically about the subject matter presented."*

In terms of using different materials, the research assistants suggested readings as well as audio-visual materials. They stated that textbooks would be boring and they would not be effective. As mentioned in the literature, it was mentioned that textbooks were little effective for the history of development of scientific ideas (Lederman, 1992). At the point of evaluation, recommendations of research assistants were predominantly tended to having no exams. In other words, there should not be grade anxiety. Other than this, the research assistants said that there could be proposals, project, presentations, homework and different activities about a specific topic chosen by students.

Some research assistants found seminars also effective while a few did not. Another point mentioned by research assistants was about instructors who should be educated because of having a crucial impact on improvement of science perception as well as effectiveness of courses. Unlike others, one research assistants did not make any suggestions because of being pleased with his graduate program.

The personal efforts of research assistants with respect to improving science perception were also asked. The big majority were interested in POS and HOS and making readings about them. Moreover, they stated that following literature and searching were helpful on improvement of science perception. A few research assistants said that watching some TV channels, like Discovery channel, enhanced their motivation and perception of science. Programs of the channels were found inspiring.

5.2. Implications

Recently, the nature of science has been a primary component of scientific literacy. Driver et al. (1996) answered the question about why understanding of the nature of science is the most important goal of science education (cited in McComas et al., 1998):

> *"An understanding of the nature of science is necessary if people are*
>
> - *to make sense of the science and manage the technological objects and processes they encounter ... (p.16)*
> - *to make sense of socio-scientific issues and participate in the decision-making process (p.18)*
> - *in order to appreciate science as a major element of contemporary culture (p.19)*
> - *to understand norms of the scientific community, embodying moral commitments which are of general value (p.19)*
> - *to support successful learning of science content (p.20).*

Many studies in the literature indicated that the history and philosophy of science enhanced students' understanding of the nature of science (cited in Rudolph, 2000; Hodson 1988; Lederman 1992; Jenkins 1996; Soloman et al. 1996; Matthews 1998).

In the light of this fact, if research assistants are considered as early academicians, having an accurate understanding of nature of science is very important for their academic development. The results of the present study indicated that the participants believed that graduate programs should pay attention for the development of science perception. According to them, the research methods course and history and philosophy courses have a positive effect on the development of science perception. Literature also supports that HOS and POS, considered as an explicit-reflective approach, enhanced the students' understanding of nature of science (Schwartz et al., 2004; Deniz, 2007). However, some studies' results indicated that the explicit-reflective NOS instructions might not be effective in helping students to improve their NOS views (Akerson et al., 2006).

The following implications are offered based on the findings of this present study:

1. A course about history of science and scientific thought should be offered to all graduate students and be a must course to all PhD students.

2. The explicit-reflective inquiry approach should be utilized in this course in order to be effective in developing epistemological beliefs and NOS views.

3. Research methods courses should be a must course for all graduate programs.

4. In order to increase scientific awareness, graduate schools should organize seminars regarding scientific thought and research ontologies.

5. Seminars in graduate programs should be designed as a mean to increase shared understanding of methodological issues and concerns in the field.

5.3. Recommendations for Further Studies

According to the findings of the present study, the following recommendations can be made:

The study was conducted only with research assistants who were PhD candidates and were belong to METU graduate programs. Thus, it is worth to perform similar studies in different universities and cities in Turkey in order to compare the results.

This study was performed only with research assistants who were PhD candidates at METU by using qualitative methods. If the study was to be conducted with all research assistants at METU by using quantitative methods, the results could be generalized confidently.

The current study investigated the opinions of the research assistants regarding the courses they take during their graduate study in terms of improving their science perception and their research skills. Thus, another study can be developed to explore

research assistants' understanding the nature of science in order to assess current situations.

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APPENDICES

APPENDIX A

RESEARCH METHODS COURSES IN THE GRADUATE PROGRAMS OF METU

GRADUATE SCHOOL OF APPLIED MATHEMATICS
Not Found!

GRADUATE SCHOOL OF MARINE SCIENCES
Not Found!

GRADUATE SCHOOL OF INFORMATICS

GRADUATE PROGRAM(S) OF COGNITIVE SCIENCES

COGS536	RESEARCH METHODS AND STATISTICS FOR COGNITIVE SCIENCE	3	3	0	8.0

GRADUATE PROGRAM(S) OF INFORMATION SYSTEMS

IS720	RESEARCH METHODS IN INFORMATION SYSTEMS	3	3	0	8.0

GRADUATE PROGRAM(S) OF MODELLING AND SIMULATION

MS591	RESEARCH METHODS IN MODSIM	3	3	0	10.0

GRADUATE SCHOOL OF SOCIAL SCIENCES

GRADUATE PROGRAM(S) OF APPLIED ETHICS

AET581	RESEARCH METH.IN APP.ETHICS	3	3	0	8.0

GRADUATE PROGRAM(S) OF BUSINESS ADMINISTRATION

BA5505	RESEARCH METHODS IN FINANCE AND ACCOUNTING	3	3	0	8.0
BA5506	QUANTITATIVE METHODS IN FINANCE AND ACCOUNTING	3	3	0	8.0

GRADUATE PROGRAM(S) OF CURRICULUM AND INSTRUCTION

EDS502	RESEARCH METHODS IN EDUCATION	3	3	0	8.0
EDS695	RESEARCH SEMINAR IN EDUCATIONAL SCIENCES	3	3	0	8.0

GRADUATE PROGRAM(S) OF EDUCATIONAL ADMINISTRATION AND PLANNING

EDS502	RESEARCH METHODS IN EDUCATION	3	3	0	8.0
EDS695	RESEARCH SEMINAR IN EDUCATIONAL SCIENCES	3	3	0	8.0

GRADUATE PROGRAM(S) OF HISTORY

HIST640	ANALYSIS OF HISTORICAL SOURCES	3	3	0	3.0
HIST641	CURRENT APPROACHES IN HISTORICAL RESEARCH	3	3	0	50.0

GRADUATE PROGRAM(S) OF HISTORY OF ARCHITECTURE

AH501	RESEARCH METHODS	3	3	0	

GRADUATE PROGRAM(S) OF HUMAN RESOURCE DEVELOPMENT IN EDUCATION

HRDE505	INQUIRY METHODS	3	3	0	

GRADUATE PROGRAM(S) OF INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY

PSY500	RESEARCH METHODS	3	3	0	

GRADUATE PROGRAM(S) OF PHILOSOPHY

PHIL501	RESEARCH METHODS	3	3	0	

GRADUATE PROGRAM(S) OF PHYSICAL EDUCATION AND SPORTS

PES600	RESEARCH SEMINAR IN PHYSICAL EDUCATION	3	3	0	8.0

GRADUATE PROGRAM(S) OF POLITICAL SCIENCE AND PUBLIC ADMINISTRATION

ADM5124	EPISTEMOLOGY AND METHODOLOGY IN PUBLIC ADMINISTRATION	3	3	0	ECTS

GRADUATE PROGRAM(S) OF PSYCHOLOGY

PSY500	RESEARCH METHODS	3	3	0	
PSY610	RESEARCH METH.IN CLINICAL PSYCHOLOGY	3	3	0	10.0

GRADUATE PROGRAM(S) OF SCIENCE AND TECHNOLOGY POLICY STUDIES

STPS605	RESEARCH METHODS AND ANALYTICAL TECHNIQUES	3	3	0	8.0

GRADUATE PROGRAM(S) OF SETTLEMENT ARCHAEOLOGY

SA502	QUANTITATIVE METHODS IN SETTLEMENT	3	3	0	

GRADUATE PROGRAM(S) OF SOCIOLOGY

SOC507	RESEARCH METHODS I	3	3	0	10.0
SOC508	RESEARCH METHODS II	3	3	0	8.0
SOC542	QUALITATIVE RESEARCH	3	3	0	8.0
SOC632	RECENT DEV. IN METHODS OF SOC. INQUIRY	3	3	0	5.0

GRADUATE PROGRAM(S) OF URBAN POLICY PLANNING AND LOCAL GOVERNMENTS

UPL603	QUALITATIVE RESEARCH METHODS	3	3	0	10.0
UPL604	QUANTITATIVE RESEARCH METHODS	3	3	0	50.0

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

GRADUATE PROGRAM(S) OF ARCHAEOMETRY

ARME543	METHODS AND TECHNIQUES IN ARCHAEOMETRY	3	2	2	8.0

GRADUATE PROGRAM(S) OF ARCHITECTURE

ARCH504	SEMINAR IN THESIS RESEARCH	0	0	2	10.0
ARCH505	ADVANCED ARCHITECTURAL DESIGN RESEARCH	6	3	6	14.0
ARCH508	RESEARCH, ANALYSIS AND DESIGN IN MULTI-LAYERED CONTEXT	4	2	4	6.0
ARCH512	ADVANCED RESEARCH IN URBAN ARCHITECTURE	3	3	0	8.0
ARCH513	INTRODUCTION TO ARCHITECTURAL RESEARCH	3	3	0	8.0
ARCH615	ARCH.RESEARCH I (ARCH. DES.]	6	6	0	14.0

GRADUATE PROGRAM(S) OF BUILDING SCIENCE

BS504	RESEARCH METHODS IN BUILDING SCIENCE	3	Contact (h/w)	Lab (h/w)	ECTS

GRADUATE PROGRAM(S) OF CITY AND REGIONAL PLANNING

CE740	DATA COLLECTION, ANALYSIS AND MODELING IN CONSTRUCTION	3	3	0	5.0

GRADUATE PROGRAM(S) OF COMPUTER EDUCATION AND INSTRUCTIONAL TECH.

CEIT520	RESEARCH METHODS IN COMPUTER EDUCATION	3	3	0	8.0
CEIT620	RESEARCH SEMINAR IN INSTRUCTIONAL TECHNOLOGY	3	3	0	8.0

GRADUATE PROGRAM(S) OF DESIGN RESEARCH FOR INTERACTION

ID503	RESEARCH METHODS IN INDUSTRIAL DESIGN I	3	3	0	10.0
ID711	QUALITATIVE METHODS FOR INDUSTRIAL DESIGN RESEARCH	3	3	2	8.0

GRADUATE PROGRAM(S) OF MATHEMATICS

MATH595	THE BOUNDARY ELEMENT METHOD & APP.	3	3	0	8.0

MATH688	FINITE ELEMENT SOL. OF DIFF. EQUATIONS	3	3	2	8.0

GRADUATE PROGRAM(S) OF OPERATIONAL RESEARCH

OR506	METHODOLOGY OF OPERATIONAL RESEARCH	3	3	2	8.0

GRADUATE PROGRAM(S) OF REGIONAL PLANNING

RP532	METHODS OF REGIONAL ANALYSIS	3	3	0	8.0

GRADUATE PROGRAM(S) OF RESTORATION

REST521	SOURCES AND METHODS OF RESEARCH IN CONSERVATION	3	3	0	10.0

GRADUATE PROGRAM(S) OF SECOND SCIENCE AND MATHEMATICS EDUCATION

SSME520	RESEARCH METHODS IN EDUCATION	3	3	0	15.0
SSME701	WRITING QUALITATIVE&QUANTITATIVE RES. IN EDUC.	3	3	6	8.0

APPENDIX B

MÜLAKAT SORULARI -Türkçe Versiyonu-

BÖLÜM-1

KİŞİSEL BİLGİLER

1- *Cinsiyet:*

2- *Yaşı:*

3- *Bölüm/Fakülte:*

4- *Yüksek Lisans/Doktora:*

BÖLÜM-2:

1. *Bir bilim insanında olması gereken özellikler sizce nelerdir? Kendinizi bir bilim insanı olarak görüyor musunuz?*
2. *ODTÜ Lisansüstü programınızda araştırma yeteneğinizi geliştirdiğine inandığınız hangi dersleri aldınız ya da hangi faaliyetlere katıldınız? (örn.Bilimsel araştırma ya da Araştırma Metotları dersleri) Dersin kodunu ve ismini belirtir misiniz?*

   A-ALMIŞSA;

   a. *Bu dersleri ya da faaliyetleri araştırma yeteneklerini geliştirme açısından nasıl bir fayda sağladığını düşünüyorsunuz?*

b. *Kendinizi araştırma yöntemleri hakkında ne kadar yeterli hissediyorsunuz?*

B-ALMAMIŞSA;

a. *Araştırma metotları gibi bir dersi almama nedeleriniz nelerdir?*
b. *Bu dersleri ya da faaliyetleri araştırma yeteneklerini geliştirme açısından nasıl bir fayda sağladığını düşünüyorsunuz?*
c. *Araştırma metotları gibi bir ders almadığınız için sorun yaşadınız mı? Peki bu problemler nelerdi? Açıklar mısınız?*

3. *ODTÜ Lisansüstü programınızda bilim algınızın gelişmesine yardımcı olacak hangi dersleri aldınız ya da hangi faaliyetlere katıldınız? (örn. Bilim Tarihi ya da Bilim Felsefesi) Dersin kodunu ve ismini belirtir misiniz?*
    a. *Bu derslerin ya da faaliyetlerin bilim algınıza nasıl bir katkıda bulunduğunu düşünüyorsunuz?*
    b. *Bu gibi dersleri almama nedeniniz nelerdir?*

4. *ODTÜ lisansüstü programınızın yapısını bilim algınızı geliştirme açısından nasıl değerlendiriyorsunuz?*

5. *Bilim algınızı geliştirme anlamında bölümünüz ya da üniversiteniz tarafından neler yapılabilir? (Herhangi bir faaliyet ya da ders)*

6. *Bilim algınızı geliştirmek için neler yaparsınız ya da yapmak isterdiniz?*

7. *Bilim algınızı geliştirmek için bir ders olsaydı, dersin;*

    a. *İçeriği,*

    b. *Metodu,*

    c. *Değerlendirmesi hakkında ne gibi önerileriniz olurdu?*

8. *Neler eklemek istersiniz?*

APPENDIX C

INTERVIEW QUESTIONS -English Version-

SECTION-1: DEMOGRAPHIC INFORMATION

1. *Gender:*
2. *Age:*
3. *Faculty/Department:*
4. *Master/ PhD:*

SECTION-2:

1. *Which characteristics do you think that a scientist should have? Would you describe your profession as a scientist?*
2. *Which courses did you attend or which activities did you participate during your METU graduate program that you think have been helpful to improve your research skills? (e.g., Scientific Inquiry or Research Methods course) List course codes and their names.*

   A-IF TAKEN;

   a. *What do you think about how these courses or activities are useful in terms of improving research skills?*
   b. *To what extent do you think yourself competence about research methods?*

B-IF NOT TAKEN;

a. *What are your reasons for not taking any research methods course?*
b. *What do you think about how these courses or activities are useful in terms of improving research skills?*
c. *Have you faced any problems because of not taking any research methods course? If yes, what were they? Could you explain it?*

3. *Which courses did you attend or which activities did you participate during your METU program that you think have been helpful to enhance your science perception? (e.g., History of Science or Philosophy of Science) List the course code and name please.*
    a. *How these courses or activities do you think contribute/ contributed to your science perception?*
    b. *What are your reasons for not taking any of these courses?*

4. *How do you evaluate the structure of METU graduate program in terms of improving your perception of science?*

5. *What can be done by your university or department to improve your perception of science? (Any activity or course)*

6. *What do you do to improve your perception of science?*

7. *If there were a course to improve your science perception, what would you suggest to include in its*
    a. *Curriculum?*
    b. *Method?*
    c. *Evaluation?*

8. *What do you want to add?*

APPENDIX D

CATEGORIES EMERGED IN THE DATA

1. Scientist

SCIENTIST	
1. Characteristics of A Scientist	
1.1.	Having A Scientific Attitude
1.2.	Following the Changes
1.3.	Pragmatism
1.4.	Being Curious
1.5.	Criticial Thinking
1.6.	Scientific Inquiry Skills
1.7.	Motivation
1.8.	Having Research Skills
1.9.	Being Suspicious
1.10.	Being Patient
2. Profession as A Scientist	
2.1.	Not Competent Yet
2.2.	Competent
2.3.	Not Competent

2. Research Skills

RESEARCH SKILLS	
1. Courses/ Seminars/ Activities	
1.1.	Taken
1.2.	Not Taken
2. Advantages of Courses/ Seminars/ Activities	
2.1.	Academic Development
3. Competence About Research Methods	
3.1.	Not Competent Yet
3.2.	Competent
3.3.	Not Competent
4. Reasons of Not Taking Courses/ Seminars/ Activities	
4.1.	Non-existence of C/S/A
4.2.	Unaware
5. Usefulness of Courses/ Seminars/ Activities	
5.1.	Improving Research Skills
5.2.	Unaware
6. Problems Because of not Taking	
6.1.	About Academic Issues
6.2.	No Problems

3. Science Perception

SCIENCE PERCEPTION	
1. Courses/ Seminars/ Activities	
1.1.	Not taken
1.2.	Taken
1.3.	Personal efforts
2. Contributions of C/S/A	
2.1.	Awareness
2.2.	Developing scientific attitude
2.3.	Ignorance
3. Reasons for Not Taking C/S/A	
3.1.	Non-existence of C/S/A
3.2.	Not Interested

4. Evaluation

EVALUATION	
1. Should-be-developed	
1.1.	Lack of courses
1.2.	Over-work of other academic responsibilities
1.3.	Instructors
1.4.	Significance
2. Positives	
2.1.	Developing Research Skills
2.2.	Improving Science Perception

5. Suggestions

SUGGESTIONS	
1. By University	
1.1.	Courses/ Seminars/ Activities
1.2.	Freedom
1.3.	Instructors
1.4.	Sufficient
2. By Personal Efforts	
2.1.	Focusing NOS
2.2.	Searching
2.3.	Scientific Activities
2.4.	Doing My Job

6. Possible Course

POSSIBLE COURSE	
1. Content	
1.1.	History/ Philosophy of Science
1.2.	Logic
1.3.	Criticial Thinking
1.4.	Scientific Changes
2. Method	
2.1.	Meterials
2.2.	Novelty
2.3.	Instructors
3. Evaluation	
3.1.	Without Exam
3.2.	With Exam

APPENDIX E

THEMATIC CODES OF DATA

	A	B	C	D	E	F	G	H
1	**1. SCIENTIST**		**Interviewees**					**F**
2	**1.1. Characteristics of A Scientist**							
3	1.1.1.	Having A Scientific Attitude	(S1, S2, S3, S4, S5, S8, S9, S11)					8
4	1.1.2.	Following the Changes	(S1, S5, S6)					3
5	1.1.3.	Pragmatism	(S1, S7)					2
6	1.1.4.	Being Curious	(S2, S3, S4, S5, S6, S8, S9, S10, S11, S12)					10
7	1.1.5.	Criticial Thinking	(S7)					1
8	1.1.6.	scientific inquiry skills	(S4, S6, S8, S10, S11)					5
9	1.1.7.	Motivation	(s6, S11)					2
10	1.1.8.	Having Research Skills	(S3, S4, S7, S11, S12)					5
11	1.1.9.	Being Suspicious	(S9, S10, S11)					3
12	1.1.10.	Being Patient	(S11, S12)					2
13	**1.2. Profession as A Scientist**							
14	1.2.1.	Not Competent Yet	(S1, S2, S3, S4, S7, S9, S11, S12)					8
15	1.2.2.	Competent	(S6, S8, S10)					3
16	1.2.3.	Not Competent	(S5)					1

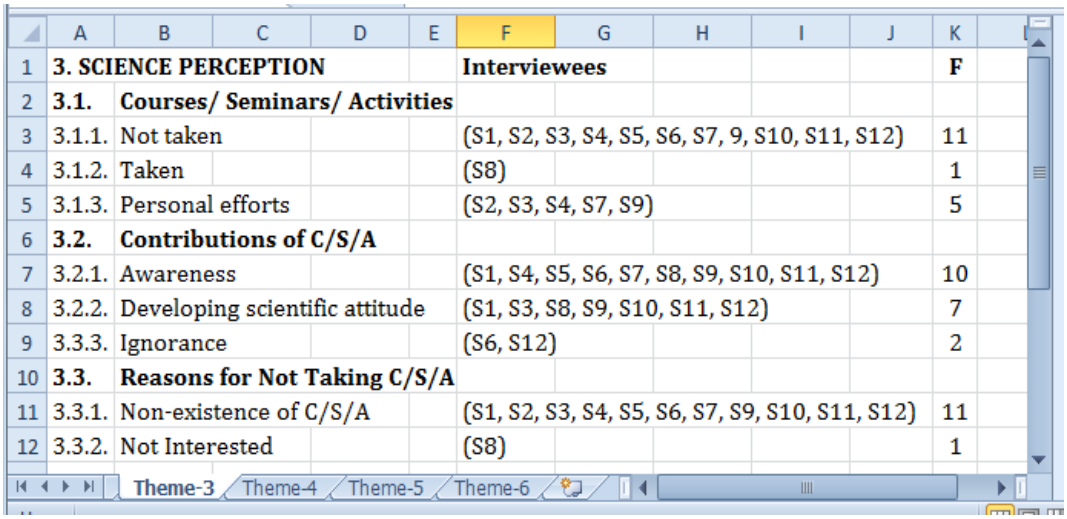
Theme-1 Theme-2 Theme-3 Theme-4

Hazır

	A	B	C	D	E	F	G	H
1	**2. RESEARCH SKILLS**				**Interviewees**			**F**
2	**2.1. Courses/ Seminars/ Activities**							
3	2.1.1.	Taken			(S3, S4, S7, S8, S10, S12)			6
4	2.1.2.	Not Taken			(S1, S2, S5, S6, S9, S11)			6
5	**2.2. Advantages of Courses/ Seminars/ Activities**							
6	2.2.1.	Academic Development			(S3, S4, S7, S8, S10, S12)			6
7	**2.3. Competence About Research Methods**							
8	2.3.1.	Not Competent Yet			(S3, S7, S10, S12)			4
9	2.3.2.	Competent			(S4)			1
10	2.3.3.	Not Competent			(S8)			1
11	**2.4. Reasons of Not Taking Courses/ Seminars/ Activities**							
12	2.4.1.	Non-existence of C/S/A			(S1, S2, S5, S9, S11)			5
13	2.4.2.	Unaware			(s6)			1
14	**2.5. Usefulness of Courses/ Seminars/ Activities**							
15	2.5.1.	Improving Research Skills			(S1, S2, S5, S6, S9)			5
16	2.5.3.	Unaware			(S5, S6, S11)			3
17	**2.6.**	**Problems Because of not Taking**						
18	2.6.1.	About Academic Issues			(S1, S5, S6, S9)			4
19	2.6.2.	No Problems			(S2, S11)			2

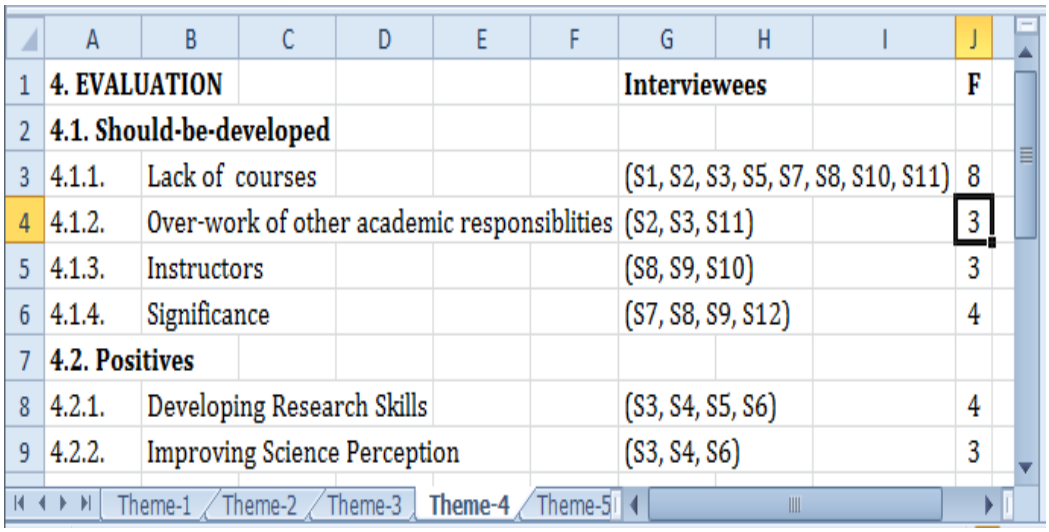
Theme-1 Theme-2 Theme-3 Theme-4

Hazır %100



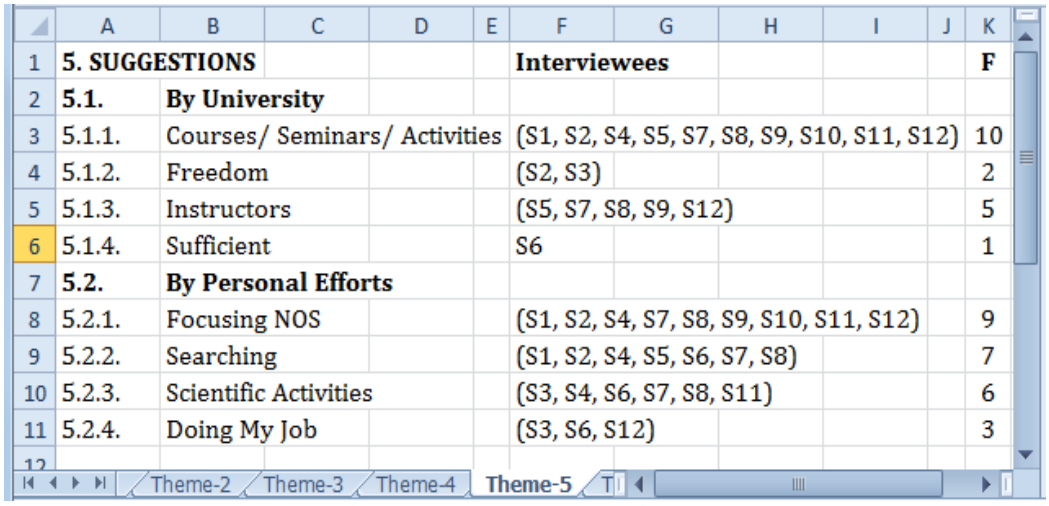
	A	B	C	D	E	F	G	H	I	J	K
1	**3. SCIENCE PERCEPTION**					**Interviewees**					**F**
2	**3.1.**	**Courses/ Seminars/ Activities**									
3	3.1.1.	Not taken				(S1, S2, S3, S4, S5, S6, S7, 9, S10, S11, S12)					11
4	3.1.2.	Taken				(S8)					1
5	3.1.3.	Personal efforts				(S2, S3, S4, S7, S9)					5
6	**3.2.**	**Contributions of C/S/A**									
7	3.2.1.	Awareness				(S1, S4, S5, S6, S7, S8, S9, S10, S11, S12)					10
8	3.2.2.	Developing scientific attitude				(S1, S3, S8, S9, S10, S11, S12)					7
9	3.3.3.	Ignorance				(S6, S12)					2
10	**3.3.**	**Reasons for Not Taking C/S/A**									
11	3.3.1.	Non-existence of C/S/A				(S1, S2, S3, S4, S5, S6, S7, S9, S10, S11, S12)					11
12	3.3.2.	Not Interested				(S8)					1

Theme-3 | Theme-4 | Theme-5 | Theme-6



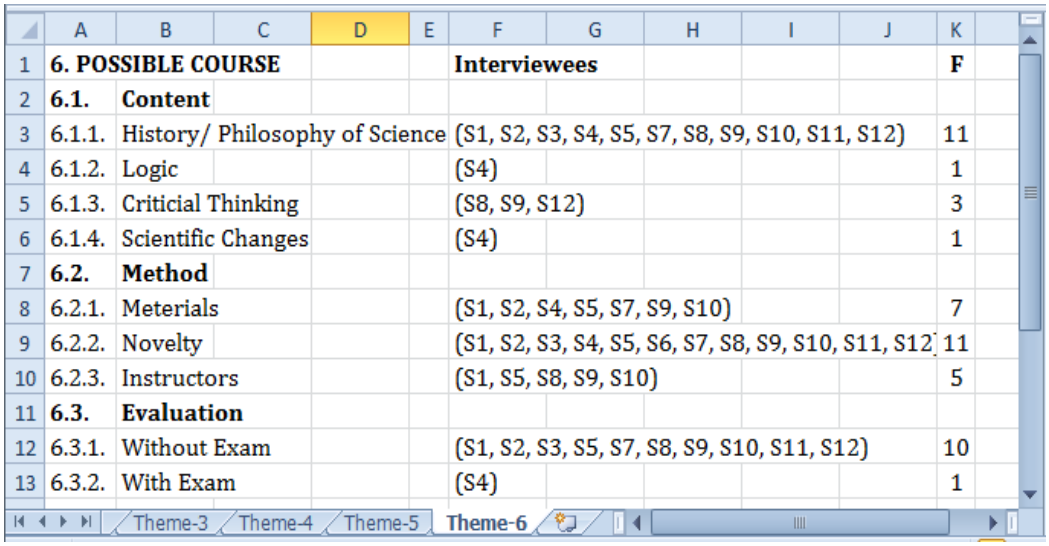
	A	B	C	D	E	F	G	H	I	J
1	**4. EVALUATION**						**Interviewees**			**F**
2	**4.1. Should-be-developed**									
3	4.1.1.	Lack of courses					(S1, S2, S3, S5, S7, S8, S10, S11)			8
4	4.1.2.	Over-work of other academic responsiblities					(S2, S3, S11)			3
5	4.1.3.	Instructors					(S8, S9, S10)			3
6	4.1.4.	Significance					(S7, S8, S9, S12)			4
7	**4.2. Positives**									
8	4.2.1.	Developing Research Skills					(S3, S4, S5, S6)			4
9	4.2.2.	Improving Science Perception					(S3, S4, S6)			3

Theme-1 | Theme-2 | Theme-3 | Theme-4 | Theme-5



	A	B	C	D	E	F	G	H	I	J	K
1	**5. SUGGESTIONS**					**Interviewees**					**F**
2	**5.1.**	**By University**									
3	5.1.1.	Courses/ Seminars/ Activities				(S1, S2, S4, S5, S7, S8, S9, S10, S11, S12)					10
4	5.1.2.	Freedom				(S2, S3)					2
5	5.1.3.	Instructors				(S5, S7, S8, S9, S12)					5
6	5.1.4.	Sufficient				S6					1
7	**5.2.**	**By Personal Efforts**									
8	5.2.1.	Focusing NOS				(S1, S2, S4, S7, S8, S9, S10, S11, S12)					9
9	5.2.2.	Searching				(S1, S2, S4, S5, S6, S7, S8)					7
10	5.2.3.	Scientific Activities				(S3, S4, S6, S7, S8, S11)					6
11	5.2.4.	Doing My Job				(S3, S6, S12)					3
12											

Theme-2 Theme-3 Theme-4 **Theme-5** T

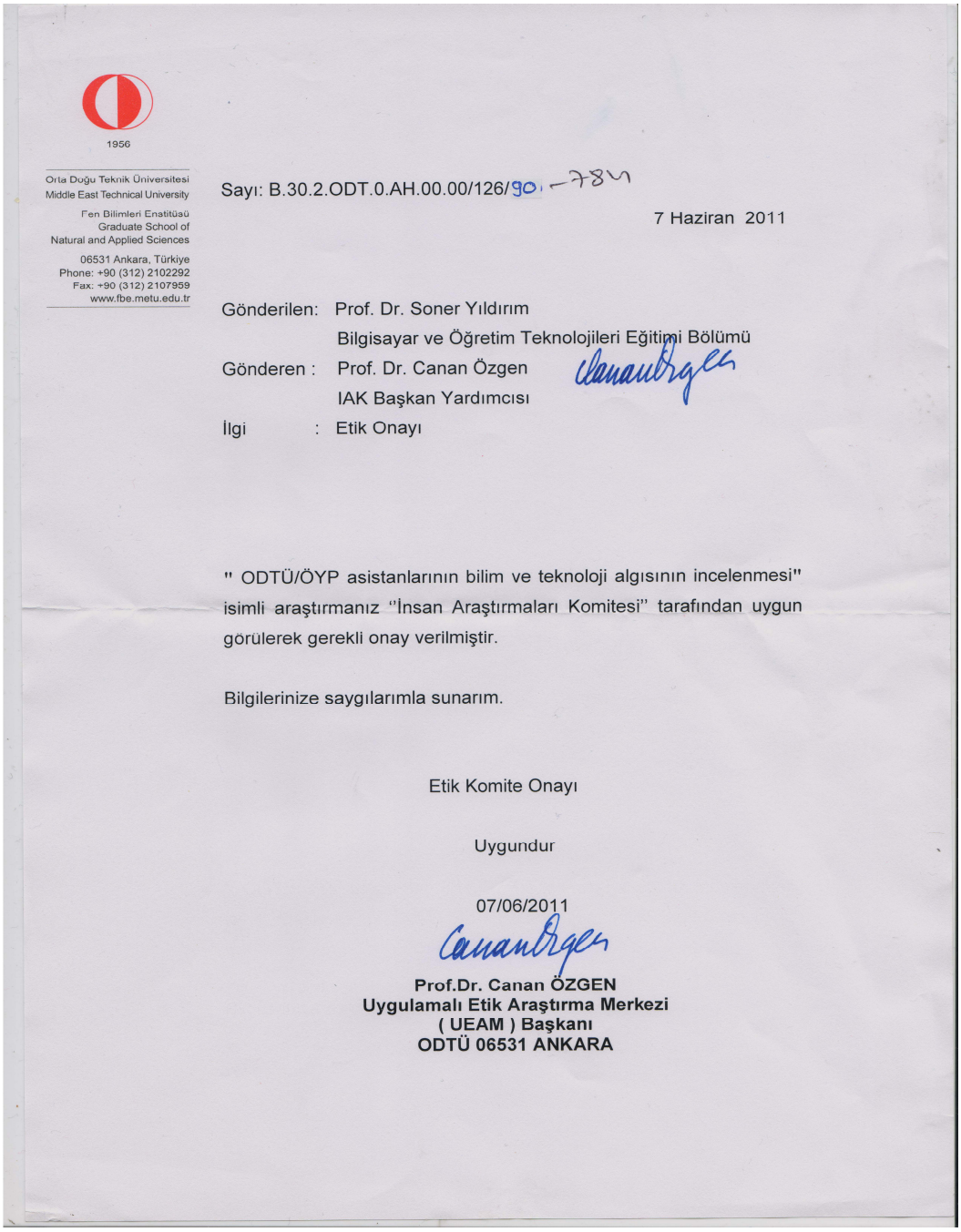


	A	B	C	D	E	F	G	H	I	J	K
1	**6. POSSIBLE COURSE**					**Interviewees**					**F**
2	**6.1.**	**Content**									
3	6.1.1.	History/ Philosophy of Science				(S1, S2, S3, S4, S5, S7, S8, S9, S10, S11, S12)					11
4	6.1.2.	Logic				(S4)					1
5	6.1.3.	Criticial Thinking				(S8, S9, S12)					3
6	6.1.4.	Scientific Changes				(S4)					1
7	**6.2.**	**Method**									
8	6.2.1.	Meterials				(S1, S2, S4, S5, S7, S9, S10)					7
9	6.2.2.	Novelty				(S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12					11
10	6.2.3.	Instructors				(S1, S5, S8, S9, S10)					5
11	**6.3.**	**Evaluation**									
12	6.3.1.	Without Exam				(S1, S2, S3, S5, S7, S8, S9, S10, S11, S12)					10
13	6.3.2.	With Exam				(S4)					1

Theme-3 Theme-4 Theme-5 **Theme-6**

APPENDIX F

ETHICS COMMITTEE APPROVAL



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7 Haziran 2011

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Bilgisayar ve Öğretim Teknolojileri Eğitimi Bölümü

Gönderen : Prof. Dr. Canan Özgen
IAK Başkan Yardımcısı

İlgi : Etik Onayı

" ODTÜ/ÖYP asistanlarının bilim ve teknoloji algısının incelenmesi" isimli araştırmanız "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

07/06/2011

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