EXPLORING THE RESEARCH ASSISTANTS' OPINIONS TO IMPROVE SCIENCE PERCEPTION AT GRADUATE PROGRAMS

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—Abstract —
The aim of this qualitative study was to explore research assistants' opinions to improve science perception at graduate programs. The research question includes the research assistants' suggestions on the improvement of the quality of the graduate program regarding science perception. 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 results were considered under the title of suggestions which could be realized by university administration and by personal efforts. In conclusion, 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.
Key Words: *Nature of Science, History and Philosophy of Science Course, Science Perception.*

JEL Classification: I21

1. INTRODUCTION

1.1. 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).

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).

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.

1.2. 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. METHODOLOGY

2.1. Research Question

The main problem is to investigate research assistants' suggestions on the improvement of the quality for their graduate program in terms of science perception.

2.2. Overall Design of the Study

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).

2.3. Participants

The study involves research assistants from Middle East Technical University which has five graduate schools: '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.

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) and purposive sampling was used in order to contact with 'knowledgeable people'.

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. The researcher's main criterion was to be a candidate in a doctorate program and having completed all courses offered their

graduate programs. This specific group was chosen in order to get overall an evaluation about their graduate programs.

2.4. 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).

2.5. 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.

2.6. 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.

3. FINDINGS

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

The research assistants made suggestions on the improvement of the quality of their graduate program in terms of science perception.

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. 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.

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 3.1.

Table 3.1.
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
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

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.

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

Table 3.2.
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

4. CONCLUSION

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).

If there was a possible course to improve science perception, the suggestions of research assistants were asked in terms of the course content. 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'.

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.

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

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