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TURKISH STUDENTS' VIEWS ON NATURE OF SCIENCE

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Abstract:
This paper explored students' views on nature of science using qualitative research techniques, mainly in-depth individual interviews. Sample consisted of 18 students enrolled on 7th grade in a small public school in northeastern Turkey. Findings revealed that students had mixed views on nature of science, as it is the case with the scientific community today. Students held contemporary views about some aspects of NOS and traditionalist views about other aspects. This study calls for improving the teaching of NOS in Turkish middle school science classrooms.

Keywords: nature of science, middle school science teaching, Turkey

1. Introduction

Helping students understand nature of science (NOS) has long been central goal of science education (AAAS, 1990). There has been a long tradition of theoretical writings concerned with establishing the cultural, educational, and scientific benefits of teaching about NOS (Lawson, 1999; Schwab, 1958; Klopfer, 1969; Lederman, 1992; Abd-El-Khalick, 1998). However, the vast majority of research forces the conclusion that the goal has been largely unfulfilled. Part of the problem can be attributed to a justifiable confusion about just what science and nature of science is (Lawson, 1999).

Typically, NOS refers to the epistemology of science and science as a way of knowing (Lederman, 1992). However, philosophers, historians, and sociologists of science, and science educators are quick to disagree on a specific definition for NOS. Such disagreement, however, should not be surprising given the complex nature of science (Lederman, 1992). Moreover, similar to scientific knowledge, conceptions of NOS are tentative and dynamic: these conceptions have changed throughout the

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development of science (McComas, 1998). There is no single NOS that fully describes all scientific knowledge and enterprises (Schwartz & Lederman, 2002) and there is always likely to be an active debate at the philosophical level about NOS (McComas, 1998). However, at the level of helping individuals understand the basic of science in order to promote an effective science literacy, there is an agreement (even though not complete) about the aspects of NOS among science educators that scientific knowledge is tentative (subject to change), empirically based (based on and/or derived from observations of the natural world), subjective (theory-laden), partly the product of human inference, imagination, and creativity (involves the invention of explanation), and socially and culturally embedded (Schwartz & Lederman, 2002). Two additional important aspects are the distinction between observations and inferences, and the functions of and relationships between scientific theories and laws (Lederman, 1992).

Abd-El-Khalick and Lederman (2000) in their critical review of literature state that results from several studies were consistent, regardless of the assessment instruments used in the individual studies, that students have not acquired adequate understanding of NOS. For instance, students thought that scientific knowledge was absolute, that scientists' main concern was to collect and classify facts in order to uncover natural laws, and that hypotheses can be proven true. Additionally, students had inappropriate conceptions of the role of creativity in science, the role of theories in guiding the scientific research, the difference between experimentation, models, hypotheses, laws, and theories. Researchers therefore argued that science curricula were not successful in improving such knowledge (Abd-El-Khalick, 1998).

As seen from the above summary of literature there is confusion about NOS even among science educators, then how we can expect students to have appropriate understanding about NOS. It is expressed in the writings of Cobern (1993) that one can pass exams and still not have had appropriate understanding about NOS. Furthermore, Lederman (1999) writes that "*teachers' conceptions of NOS do not necessarily influence their classroom practices.*" All these writings suggest improving teaching of NOS. The study attempts to explicate Turkish students' perceptions of NOS. Such information should provide useful data to increase our understanding of NOS's perception among students.

2. Methods

The sample (10 girls and 8 boys) of the present study ware students from a small public middle school in Northeastern Turkey who were seven graders in the Spring of 2012. The study employed qualitative research methods, by using in-depth interviews; the study explored the 'culture-sharing' behaviors, beliefs, and language among Turkish

students (Creswell, 2002). Study focused on how students' views emerge. In-depth, open-ended nature of interviews, as Bogdan and Biklen (1998) write, "*allows the subjects to answer from their own frame of reference rather than from one structured by prearranged questions*" (p.3). Also, the study used loosely structured interview guides, as recommended by Bogdan and Biklen (1998), in order to "*get the subjects to freely express their thoughts around particular topics*" (p.3). In the study, this topic was an understanding of NOS. Lederman (1992) stressed the importance of using individualized interviews to produce accurate representations of respondents' NOS views. Loosely structured interview questions used in this study were developed by the researcher and with the help of some science educators, by looking at various survey instruments measuring students' and teachers' understanding of NOS, such as VNOS-A, B, C questionnaires (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002), and by finding and adding additional questions after each interview. Thus, the development of the questions was evolutionary in nature, they evolved over time. Interviews were recorded on a digital voice recorded and later transferred to PC computer.

3. Findings

3.1 Definition of Science

When defining science 7 students used the following words "*discovery, invention, exploration"* and four students said that it is "*curiosity*" and again four said it is "*an experiment, an inquiry, and an observation"*. Two participants said science is "the work that scientists do" one said "*science comes from human needs*" and one said "*science is something proven with scientific work*." These views are in line with the current science education literatures' views on NOS (Lederman, 1992; Karakas, 2009).

3.2 First Encounter with Science

Majority of the participants (12) said that they first encountered science in school on 4-5-6 grades in Science and Technology course. For instance, one student said "*in fifth grade when doing some experiment, we saw the oil coming from a walnut*" another said "*on 5th grade while doing an experiment with electrical circuits*". Two participants said that their first encounter with science was on TV one said "*when I was 7-8 years old there was programs about Einstein and Graham Bell on TV."* One student said "*in kindergarten the teacher did an experiment with egg*" and another said "*my father works with computers and my interest in science started very early, I had the desire to design new stuff from that age.*" Turkish students' first encounter with science generally starts in middle school, which is very late if Turkey wants to compete with the developed world. These findings show that Turkey should find ways to bring science in kindergarten.

3.3 Advancement in Science

Majority of the participants said that science advances with "*curiosity, by doing experiments, and by proving new ideas".* Six participants said "*science advances to find solutions to human needs,*" two said "*by constantly bringing out new ideas,*" one said "*science advances with imagination*," and another said "*it advances with technology*." These findings show that students understand that science is experimental, needs imagination, and is socio-cultural (answers society's needs) these views are in line with the current science education literatures' views on NOS (Lederman, 1992; Karakas, 2009).

3.4 Socio-cultural Nature of Science

There were two sub-themes in this category and they are as follows:

A. Society's role in science

All of the participants said that society affects science. Seven students said "*society's needs affect in what way science will advances."* One male student said "*society's development level influences how science advances. For example, let's compare America (USA) and Iran. America is more advanced country and its needs gradually diminish, because it continuously meets its needs."* One student said "*society has economical contribution*" and another said "*in the past some rulers were against the science and science was not able to advance."*

B. Different cultures contribution to science

Majority of the participants said that different cultures influences science differently. One student said "*for example Chinese found the gunpowder for entertainment purposes, and the Europeans used it to make guns."* Another said "*in the past some scientists were killed just for their ideas."* Two students said "*if the society is inquisitive it will have some influence on science."* These findings show that students understand the socio-cultural nature of science and they are in line with the current views on NOS (Lederman, 1992; Lederman at.al., 2002; Karakas, 2009).

3.5 The Creativity and Imagination in Science

All of the participants said that creativity and imagination are very important in science and these views are in line with the current views on NOS (Lederman, 1992; Abd-El-Khalick & Lederman, 2000; Karakas, 2009). Some students' views were as follows:

> *"People who have more imagination influence science much more"*
>
> *"Imagination is very important, you can still have science without it, but you need creativity"*
>
> *"If people do not use their imagination, they cannot make important discoveries"*
>
> *"Science starts with imagination and creativity"*

"Can I give you an answer in percentages? Of course (interviewer) %90"

"If there is no creativity science cannot advance"

3.6 The Relationship between Theory and Law in Science

Majority of the students said that law is proven and theory is not yet proven scientific knowledge. These findings show that students' views on this aspect of NOS are in contrast with the current science education literature. (Lederman, 1992; Abd-El-Khalick & Lederman, 2000; Karakas, 2009). Theory and law in science are completely different things, theory is just someone's explanation for why a certain part of the physical world is the way it is, or just a description, law on the other hand is immediately grounded in the empirical, law has something more to do with the way the world really is and theory has more to do with the way we look at it. Some students' views were as follows:

"Theory are some ideas put forward, law are proven ideas"

"Theory is fictitious, law is decided"

"In science theory is humans' ideas; law is things happening in nature"

"Law is related to nature, for example it is impossible for humans to fly, and scientific theory is scientific thinking"

3.7 Subjectivity in Science

Majority of the students said that scientists must be neutral and should not have any prejudice. Some students' views are as follow:

"For me people should be neutral, if a person does a science according to his views and liking, the things that they discover would not be useful, it would not be able to meet other people's needs."

"Person with prejudice cannot do science, because he or she will be confined"

"Person with prejudice cannot do science, Einstein for example did thousands of experiments, and he was not a very studious student, but if he was to give up in the beginning he would not be able to discover the things that he discovered"

Eight students said that scientists when they do science they project their views on their findings:

"They project a lot, because every human's judgments are different"

"They do not project too much; there is a prejudice, maybe they are afraid that the things that they expect will not realize"

"May be there is a little subjectivity, because they make personal remarks"

"Scientists' interpret science in a way that everyone will understand and like"

"Scientists must project their prejudices, because they are the ones who do the experiments, they must advance in their pace, even if they project their judgments they must be honest"

These views are not totally in line with the current views on NOS (Lederman, 1992; Abd-El-Khalick & Lederman, 2000; Karakas, 2009). Turkish students' views on the subjective nature of science are mixed, but this aspect of NOS is highly debated in the science education literature and scientists also have mixed views on this aspect.

3.8 Observation and Inference in Science

Majority of students clearly distinguished between observation and inference in science. Some students' views are as follow:

"Observation is real, inference I do not know"

"Observation is very important in science, inference I do not know"

"Observation is doing experiments and seeing the results, inference I do not know"

"Observation is something you see after research, inference I do not know"

"Observation is experiment and research, inference is a guess"

"Observation is examination, inference is its result"

"Observation is doing and experiment and seeing the results, inference I think is interpretation"

These views are not totally in line with the current views on NOS (Lederman, 1992; Abd-El-Khalick & Lederman, 2000; Karakas, 2009). Turkish students' views on this aspect of NOS are mixed.

4. Conclusion

The study suggests that Turkish students had mixed views on NOS, as it is the case with the scientific community today (Karakas, 2009). Students held contemporary views about some NOS aspects and traditionalist views about other aspects. The findings show that students understand that science is experimental, needs imagination, and is socio-cultural (answers society's needs). Majority of students clearly distinguished between observation and inference in science all of the participants said that creativity and imagination are very important in science. On the other hand, majority of the students said that law is proven and theory is not yet proven scientific knowledge. This calls for examining the textbooks, because majority of the textbooks still write that law is proven and theory is not yet proven scientific knowledge in Turkey. This study in general calls for improving the teaching of NOS in Turkish schools.

References

1. American Association for the Advancement of Science [AAAS]. 1990. *The Liberal Art of Science.* Washington, D.C.: Author.
2. Abd-El-Khalick, F. (1998). The influence of history of science courses on students' conceptions of nature of science. *Doctoral dissertation*. Oregon State University
3. Abd-El-Khalick, F., & Lederman, N.G. (2000). Improving science teachers' conceptions of nature of science: A critical review of the literature. *International Journal in Science Education, 22* (7), 665-701.
4. Bogdan, R.C., & Biklen, S.K. (1998). *Qualitative research for education: An introduction to theory and methods.* (3rd ed.). Boston, MA: Allyn & Bacon.
5. Cobern, W.W. (1993). College Students' Conceptualizations of Nature: An Interpretive World View Analysis, *Journal of Research in Science Teaching*, 30(8), 935-951.
6. Creswell, J.W. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Upper Saddle River, New Jersey: Merrill Prentice Hall.
7. Karakas, M. (2009). Cases of science professors' use of nature of science. *Journal of Science Education and Technology, 18*, 101-119.
8. Klopfer, L.E. (1969). The teaching of science and the history of science. *Journal of Research in Science Teaching*, 6, 87-95.
9. Lawson, A.E. (1999) What Should Students Learn About the Nature of Science and How Should We Teach It? *Journal of College Science Teaching*, 401-411.
10. Lederman, N.G. (1992). Students' and teachers' conceptions of the nature of science: A review of the research. *Journal of Research in Science Teaching, 29* (4), 331-359.
11. Lederman, N.G., Abd-El-Khalick, F., Bell, R.L., & Schwartz, R.S. (2002). Views of nature of science questionnaire (VNOS): Toward valid and meaningful assessment of learners' conceptions of nature of science. *Journal of Research* in Science Teaching, 39(6), 497-521.
12. McComas, W. (1998). The principal elements of the nature of science: Dispelling the myths. In W. F. McComas (Eds.). *The Nature of Science in Science Education Rationales and Strategies,* (pp.53-70). Netherlands: Kluwer Academic Publishers.
13. Schwab, J.J. (1958). The teaching of science as inquiry. *Bulletin of Atomic Scientists, 14,* 374-379.
14. Schwartz, R.S. & Lederman, N.G. (2002). 'It's the nature of beast': The influence of knowledge and intentions on learning and teaching nature of science. *Journal of Research in Science Teaching*, *39*(3), 205-236.