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STS from a Historical Perspective and its Reflection on the Curricula in Turkey

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Abstract: The purpose of this paper is to give historical perspective foundational points of Science, Technology and Society (STS), the reasons of STS's being involved in Science Educations Programs, and the effort of connecting and integrating STS on the curricula and in this respect, the condition in Turkey is tried to be put forth.

Key words: STS, Science Curriculum, Influences of STS on Curricula, Educational Reform in Turkey.

INTRODUCTION

Modern science and identically the development of technology caused the society a series of troublesome challenges. Especially, the scientific developments since 17th century (with Newton, Galileo, Bacon, and later on with Darwin) caused great conflicts with religion. With the industrial revolution starting again in 17th century, economical and political problems came out. None of the present political systems (such as socialism, capitalism, and democracy) could make solutions to these problems. The destruction caused by the use of chemical and nuclear weapons in the World War I and II, and after that the environmental pollution come out simultaneously with the technologic development in the period of cold war increased the troubles which science and technology made for the environment.

While science and technology caused troubles, there were facilities which they brought to social life. In order to overcome these troubles, to understand the relationship between science and technology thus to identify its effects on social life, the need of involving the interactions between Science, Technology, and Society (STS) into the educational programs has blossomed.

"STS" is contested acronym. It is diverse and multifaceted. Indeed, STS has itself been interpreted to stand both for "science, technology, and society" and for "science, technology studies" (Mitcham, 1999). Most of STS leaders refer it as a movement. Although STS is not identified as a major example of the visions for science education, most STS researchers have concluded that the visions elaborated in the standards correspond perfectly to the STS efforts in the United Kingdom, Netherlands, Israel, Japan, and Korea. The National Science Education Standards visions for reform also correspond to the efforts to define science programs around current issues led by the United Nations Educational, Scientific, and Cultural Organization and the International Council of Associations for Science Education (Yager, Abd-Hamid & Akcay, 2005).

Hurd (1991) described more than three decades of work on STS as part of change initiatives in science education in the United States, thus supporting a long history of interest in using STS principles in instruction. Similarly, Kumar and Berlin (1998) found that STS programs were implemented as early as 1966 and 1970 in Vermont and Delaware, respectively. As of 1993, STS had been required recommend, or encouraged part of state science curricula in 38 states in the United States (Kumar & Altschuld, 2000).

Similar changes have started in Turkey as well as other countries though later. Initially, it is observed that a main goal which is appropriate for STS was included in the science educational program in 1992 curricula although it was too superficial. STS had more part in 2000 and 2004 Primary Science Curricula. STS was referred as STS-E (Science-Technology-Society-Environment) in 2004 Primary School Science Curricula.

This study consists of two main sections. In the first section, what the main themes in STS are historical perspective of the STS and why STS must be included in science educational programs are focused on. In the second section, the qualities that need to be in a science curriculum which involves STS approach are determined and then 2004 Turkish Primary Science Curricula is evaluated according to these qualities.

STS from a Historical Perspective

The meaning of STS differs from person to person. This stems mainly from a series of important reasons which are historically broken from each other. Science in the 17th century England gradually became politicized. In this period, Bacon played a major role. The book "The Advancement of Learning" which was written by Bacon and dedicated to the king of England James I, perhaps was the first book written about the benefits of STS education. So, Francis Bacon can be said to be the first person who mentions STS. The science program offered by Bacon had a large perspective. He mentioned both pure science and its application, i.e., technology (Solomon, 1993).

In those times and till the beginning of 1900s, science mainly remained as an aristocratic work. According to Solomon (1993), science's remaining as an aristocratic work is a reflection of that period's contemporary culture; whereas, this structure destroyed the scientific attempts in different ways.

From this historical perspective, it is observed that science suffered from the distinction between abstract thought, i.e., theories and technological applications. This distinction caused to be delayed several improvements. It is seen that there were decades (sometimes more 100-year time) between the times of any abstract theory and relevant technologic developments time coming on the stage. Here, the disconnection between the generators of knowledge and its applicators plays the main role.

Starting from 1930s, science was not an aristocratic work any more; therefore, became presentable to whole society. A group of radical scientists like J. D. Bernal and L. Hogben made great efforts on science's becoming the work of people apart from aristocratic work. According to this group, one of the main goals of STS is to give personal and social freedom by means of science rather than the Baconian benefits of it (Solomon, 1993).

The role of science in the tragedies during and after World War I and II is explicitly known. As everybody knows, in general, World War I is known as "the war of Chemists" and World War II as "physicians." The reason is this the chemical gases which are produced and used in World War I and the atom bomb which is used in World War II caused hundred thousands of people either to die or to become physically disabled. Therefore, not only science but also attitudes of scientific performers must be considered as responsible.

The Reasons of STS's being involved in Science Educational Programs

The societies who witnessed the effects of technological developments in the environment started to follow these with the help of Civil Society Organizations. Especially, increasing environmental pollution gradually and the results of these affected the communities that experienced this pollution. Environmental movements blossomed as a result of this and they tried to gain more knowledge about scientific activities and to transfer this knowledge every section of society. Yet, in a very short time it was understood that the knowledge gained about scientific activities was not sufficient. At this point, people realized that they should understand the science itself as well. Thus, new reasons aroused so as to perform science education in a more effective way. Departing from this point, Solomon states that "All people need some science education so that they can think, speak and act on those matters, related to science, which may affect their quality of living" (1993, p.15).

One of the foundations providing to cover STS in science education program is the report "The Limits of Growth" (Meadows et al., 1972; Cited, Solomon 1993) published by a group of intellectuals, economists, and businessmen who were in the organization of "The Club of Rome." This report caused to begin a disputation between the consumption of fossil fuel which increases logarithmically and the reservation of the limited fossil fuel in nature, and the population explosion in the world and the production of limited food (Solomon & Aikenhead, 1994). With this report, there was a new goal of science education program within the light of comprehension: Science Education Programs should cover global problems as well as problems of the third world countries. Therefore, STS, with the emphasis on social responsibility, removes the deficiency which is needed in the science education program. By means of this understanding, it was observed that STS was needed for education in terms of economy and industry.

Approaches to instruction in science education such as science-technology-society (STS) could play an important role. STS takes into consideration the interactions between science, technology, and society (Hurd, 1991). During the instructions, teachers should emphasis the importance of how science, technology, and society should interact with each other. Zoller (1992) mentioned that while all students should be informed with the content and the process of the science, teacher should create an environment to help students' to understand science and the society impact each other.

The reflection of STS on Science Educational Programs

STS was as a movement. STS programs emerged at various universities in the United States, Europe, and Australia, not always using this exact phrase. Examples include, for instance, the Science in a Social Context or SISCON program in U.K. and the Values, Technology, Science, and Society or VTSS program at Stanford, both from the 1970s. When STS played a role in K-12 science education it was often time hyphenated as Science-Technology-Society and used as an adjective to qualify curriculum content. During the 1980s a number of university departments such as those at Cornell University and Rensselaer Polytechnic Institute reinterpreted the acronym to stand for science and technology studies, and took steps to transform the interdisciplinary field into a scholarly discipline with all the accoutrements thereof – from tenured faculty lines and degrees to journals and textbooks (Cutcliffe and Mitcham, 2001; p.2).

STS started to become clear with the attempts to develop two programs in U.K. as a reformation in 1970s. The first of these programs is "Science in Society" and the other is SISCON as it is mentioned above. STS as a science – education term was introduced in the U.S. when the U.K. projects became conversation pieces at national meetings and in 1978 when the National Science Foundation (NSF) funded Project Synthesis to determine where U.S. science education was and where it should go in the immediate future. STS became an established science education movement in the U.S. when the National Science Teachers Association proclaimed that the major purpose of science education was to produce persons who were

Table 1. Features Characterizing Excellent STS Programs

1	Prepare individuals to use science for improving their own lives and for coping with an increasingly technological world.
2	Prepare students to deal responsibly with technology/society issues.
3	Identify a body of fundamental knowledge which students may need to master in order to deal intelligently with STS issues.
4	Provide students an accurate Picture of the requirements and opportunities involved in the multitude of careers available in the STS area.

scientifically and technologically literate (NSTA, 1990; Cited, Yager, 2001; p.84)

Following this, NSTA initiated "Project for Excellence" in 1982. Accordingly, NSTA defined excellence in the area of science-technology-society as programs that accomplish the four actions indicated in Table 1.

In addition to this NSTA in context of "Search for Excellence" proclaimed that exemplary STS programs should include six opportunities (Yager, 2001):

To learn about the energy involved in a variety of areas –from talking long, hot showers, to potential indoor pollution resulting from sealing houses too tightly against drafts, to the world impact of increasingly rapid growth of energy use throughout the world.

To discuss natural control of populations, the effect of technologies on population growth, and impact of rapid changes of population growth on specific subsets of the world society.

To develop student awareness of the effects of personal and societal decisions on all aspects of the environment – from paper and food on the floor of the cafeteria, to the balance of gases in the atmosphere, to the "noise" of home stereo systems.

To encourage students to question the apparent waste in various technological programs as well as the potential benefits.

To deal with the complexity of day-to-day decisions related to science and technology. For example, while it can be demonstrated that 45 mph is a more energy –efficient speed at whish drive most autos, the national speed limit is 65 mph. The sociology behind such regulations should be understood along with the technology. Similarly, the automation of supermarkets has been technologically feasible for many years. However, the sociology involved in gaining public acceptance for this system has slowed down its implementation.

To consider such issues as weather control, test tube babies, genetic engineering, space shuttles, nuclear energy, and a myriad of technological developments that require an education which enables individuals and groups to make intelligent decisions on support or opposition to such Technologies (p.85).

Table 2. NSTA STS Program Features

1	Student identification of problems with local interest and impact.
2	The use of local resources (human and material) to locate information that can be used in problem resolution.
3	The active involvement of students in seeking information that can be applied to solve real-life problems
4	The extension of learning beyond the class period, the classroom, the school.
5	A view science content which is more than concepts which exist for students to master on tests.
6	An emphasis on process skills which students can use in resolving their own problems.
7	An emphasis on career awareness – especially related to science and technology
8	Opportunities for students to experience citizenship roles as they attempt to resolve issues they have identified.
9	Identification of ways that science and technology are likely to impact the future.
10	Some autonomy for students in the learning process (as individual issues are identified).

Table 3. STS Criteria Derived From the National Science Education Standards

Item	STS Categories and Content Standards
	Science and technology
1	Abilities to distinguish between natural objects and objects made by humans
2	Abilities of technological design
3	Understanding about science and technology
	Science in personal and social perspectives
4	Personal and community health
5	Characteristics and changes in populations, population growth, resources, and environments
6	Types of resources and natural resources
7	Changes in environments
8	Environmental quality
9	Risks and benefits
10	Natural and human-induced hazards
11	Science and technology in society
12	Science and technology in local, national, and global challenges
	History and nature of science
13	Science as a human endeavor
14	Nature of science and scientific knowledge
15	History of science and historical perspectives

Source: Kumar & Berlin (1998)

In 1990, NSTA put forward the fact that STS is a need that should be taken up as a reform in the education of science and technology. At the same year, a position paper published by NSTA described STS as those where certain features were in evidence. In Table 2, these features are listed.

National Science Education Standards (NSES) is one of the documents which put forward the fact that STS in educational programs is not given importance adequately. STS Categories and Content Standards which Kumar & Berlin (1998) found out from NSES and used in their studies are given Table 3.

Brief Description of Turkish Education System

Those unfamiliar with Turkish culture need to know that education is the guarded by the Turkish Ministry of Education responsibility. As a result, Turkey has same educational system and same national science curriculum in every part. ………

The preparation of a citizenry capable of competing in an increasingly global society influenced by science and technology has been a prominent goal of science education reform efforts in the United States and in the most of other countries (Kumar & Altschuld, 2000).

STS was not in the curricula in Turkey before 1992. First of all, it can be said that STS has been only mentioned in one item in the list of general goals of 1992 Primary Science Curricula. According to this (MEB, 1992):

Technological development and the consciousness of environment were given in a balanced way. The thought of technological development's being as a matter of fact for societies, but thus should be done systematically. The thought 'continual and balanced development' is given successfully. The respect of nature is one of the fundamental features of this program (p.9).

Afterwards, the expressions which were appropriate for STS were placed in the vision of the program and in general goals even though they were not named explicitly in primary science curricula reformed in 2000. For instance, one of the vision expressions in 2000 curricula is like (MEB, 2000):

The education of science must achieve students become individuals who can grasp both the importance of scientific developments based on observation and data rather than their idée fixe. As a result, they can differentiate the effects of those developments in the technology, society, and environment (p.8).

Furthermore, the acquirements about STS are placed in every unit level. Some of the samples of those acquirements added to the end of units in 2000 Science Curricula are listed below (MEB, 2000):

illustrates the composition of air, water, and earth with the variety of ratio in their structure, and the pollution if there is an addition of any harmful substance,

explains the effects of air pollution on livings by emphasizing the factors which pollute air,

searches for the studies concerning the preservation of air, water, and earth, develops projects and gives information related to these,

- illustrates the noise pollution, indicates its negative effects on human health and precautions which must be taken,
- illustrates how the variable environmental factors can harm the plants,
- gives examples of tools which are composed with the help of the structure of eye and their usage,
- realizes that if used batteries are directly thrown in the garbage, they may pollute the environment; thus, states the precautions,
- identifies the role of pressure in water supply,
- gives examples of the usage of balloons,
- illustrates the necessity of scientific investigation and investment concerning the issues of environment,
- discusses the importance of sustainable progress concept defining what it is.

2004 Primary School Curricula is the first program in which STS has its name. STS-E, one of the main dimensions of 2004 Primary Science Curricula, stands for a reason which changes the name of the course "Science" into "Science and Technology" later on.

2004 Science and Technology Course Syllabus include seven learning areas developed so as to enlarge the vision of students' becoming legitimate in science and technology. Four of these areas constructed as "Content Learning Area" to organize basic science concepts and principles for students' learning. Other three areas are named as "Skills, Comprehension, Attitude, and Value Learning Area" where STS is referred as "STS-E."

In the STS-E dimension of this program, students' understanding of the nature of science and technology, their interaction between each other, the society and the environment is emphasized and thus knowledge, comprehension and skills should be used with the problems related to science and technology.

The acquirements of STS-E learning environment, given in the program of every level, are integrated into content learning areas in the unit programs and the students are provided to acquire those listed below. Therefore, the students educated according to this program (MEB, 2004):

- realize the nature of science and technology, the relationship between them, and their interaction with society and environment,
- apply the tools, process, and strategies concerning the issues of science and technology,
- improve necessary information and skills so as to build up critical and responsible attitudes towards innovations,
- internalize the development of scientific discoveries, technological variety, and the changes occurred in people's knowledge and minds in the various individual and social contexts from past to the present,
- become aware of various values, perspectives, and decisions related to science and technological issues and behave responsibly,
- search the scientific processes and technologic solutions by questioning,
- improve responsible and creative solutions using science and technology.

In the program, there are totally 36 acquisitions which students must acquire in STS-E learning area. Some of them are stated below (MEB, 2004):

- realize that the applications of science and technology may affect the individual, society, and environment whether positively or negatively,
- specify daily problems that can be solved by technology and generate ideas for solution after gathering data,
- realize that scientists are not common men,
- witness the promotion of men and women who preferred theoretical and practical science as their occupations,
- realize the fact that waste (domestic, industrial, medical, institutional, etc.) must be properly recycled or destructed in order to prevent the harm it may cause for the environment and the management of waste produced by technologic systems (chemicals, plastics, metals, etc.) is very crucial social problems,
- describe how to us these technological products and systems so as to protect natural sources, livings, and habitants,
- illustrate that there may be a particular scientific and technologic development affecting the individual, society, and environment positively or negatively, presupposed or not.

The perspective of STS as it stated in the program's name is expressed concretely in the acquisition part of the units. Also, there are sample activities related to STS in every unit.

CONCLUSION

Traditional approaches of science teaching and STS orientation are two extremes of spectrum of teaching strategies. It is obvious that teachers who use traditional teaching strategies in her/his class throughout her/his life; it is not an easy process to shift STS approaches in very short time. It is important to prepare educational programs for science education according to STS, but it is insufficient. Besides, a teacher should be trained according to STS before and during the service. Another important point is that, the curriculum materials (science kids and printed materials) should be prepared relevant to STS activities as well as the programs to support and help science teachers to implement STS activities while they were teaching.

Science education prepared according to STS is not only a must (or necessity), but also a suitable tool to see the interactions between scientific discoveries, technological developments and their effects on the values of the society. Yet, as mentioned above, the program itself cannot be sufficient enough to achieve the goals presented at the Turkish National Curriculum.

Furthermore, the science-technology-society (STS) movement recognizes the need for education that prepares young people for the challenges of an ever changing, interdependent world. If today's students are to become tomorrow's decision makers, they need knowledge of science, technology, and society that is global in scope (Merryfield, 1991, p. 288). Consequently, our dream of leaders and societies who can bravely make radical decisions about the precautions of global heating, which contemporary leaders cannot take, will come true.

In traditional science curriculum, science content is taught in segregation "technology" and from "society (Solomon & Aikenhead, 1994). With the new perspective of STS science curriculum in Turkey, science content is connected and integrated with the students` life and everyday worlds. All these efforts prove the importance of STS's reflection on the curricula. A very major step was taken when the curricula-makers in Turkey realized this importance though later than many other countries. This initial step taken in the name of 2004 Science and Technology Course will show its effects during evaluating the program in the future.

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