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STUDENTS' OPINIONS ABOUT SCIENCE AND TECHNOLOGY IN TURKEY AND THE UNITED STATES: A CROSS-CULTURAL STUDY

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Abstract

The aim of this study is to determine the thoughts of Turkish and American middle school students on science and technology. One intact school was assigned randomly for this study from both countries. The sampling of the study contains 479 students (363 Turkish students, 116 American students) from two countries aged between 11 and 13. The data for the study were obtained by using ROSE Survey. The results of the study revealed similarities and dissimilarities on science and technology between the students of the two countries. The findings of the study are thought to improve the education of universal science and technology and to contribute to the researchers doing research on comparative education and cultural diversity and to the literature of international science education.

Keywords: curriculum and instruction, science education, middle school

1. Introduction

In recent years, there has been an international movement towards educational reform, particularly in science and technology education, focused on the expected needs of a sustainable environment, economy, and society (UNESCO, 2015). It is known that science and technology education will aid in developing scientific literacy among today's youth and thereby help to enable tomorrow's population to have a better understanding of the world around them and to make environmentally sensitive decisions. Within this context, we expect all countries to attach similar importance to science and technology education.

In recent years, international studies related to science and technology education have received tremendous publicity (Potvin & Hasni, 2014). Comparative research can support the efforts to develop global competency; assessing the extent to which students have such competency, carefully documenting the various approaches to global education used comparatively, and analyzing the contributions of those diverse curricula and pedagogies (Reimers, 2013). In this context, we must start rethinking our curriculum development process under changing national and international conditions. The challenge becomes how to teach learners to make sense of the vast amount of information they encounter every day, identify credible sources, assess the reliability and validity of what they read, question the authenticity and accuracy of information, connect this new knowledge with prior learning and discern its significance in relation to information they already understand (Facer, 2011). Thus, most of the curriculum reform reports refer to learner centered or humanistic curriculum. One of these reports published by the UNESCO entitled “Rethinking Education towards a global common good?” In a chapter of the report entitled “Rethinking of curriculum development” answers the following question “What would a humanistic curriculum look like from the perspective of policy formulation and content?” Regarding learning content and methods, a humanistic curriculum is certainly one that raises more questions than it provides answers. It promotes respect for diversity and rejection of all forms of (cultural) hegemony, stereotypes and biases. It is a curriculum based on intercultural education that allows for the plurality of society while ensuring balance between pluralism and universal values. In terms of policy, we must recall that curriculum frameworks are tools to bridge broad educational goals and the processes to reach them. For curriculum frameworks to be legitimate, the process of policy dialogue to define educational goals must be participatory and inclusive (pp. 41-42).As emphasized in Reimers’ article (2013), in this world, people will have to negotiate how to adopt ethical and legal frameworks amidst cultural pluralism, they will have to figure out their common humanity and their differences with others who come from different cultural and civilizational origins, they will have to decide how to trust and collaborate across such differences, often bridging space and time through science and technology. To the extent that such cross- national comparisons serve to stimulate programmatic innovation in the participating countries –inspiring the design and implementation of programs which comparative evidence suggest might be promising avenues to better support the opportunities for students to gain such skills –the inclusion of global education provides a unique point of entry to program innovation explicitly focused on the development of 21st century skills. Global competency, itself a 21st century skill, should be understood through the multidimensional lens which defines the human capabilities for life and for work. Innovation in the participating countries –inspiring the design and implementation of programs which comparative evidence suggests might be promising avenues to better support the opportunities for students to gain such skills— the inclusion of global education provides a unique point of entry to program innovation explicitly focused on the development of 21st century skills (p. 1).

More research interest was placed on nations comparable to the United States (Peak, 1996; Wang, 1998). At the national level, especially for Turkey, Turkey and the United States seem to be a better choice for comparison. Although Turkey and the United States seem different countries in terms of culture, geography, economy, history, it is particularly useful to compare data from Turkey and the United States for several reasons. First, the strong historical links between Turkey and the United States mean that the Turkish educational and training systems continue to show parallel developments even now.

During this first phase of educational reform in Turkey, John Dewey’s, who an eminent American educator, advice and recommendations have been influential on how to improve the Turkish educational system. Dewey visited the newly established Republic of Turkey in the summer of 1924. He studied Turkish education system and submitted a report on ways to improve it. After Dewey’s studies, some American educators and foundations such as Kate Wofford in 1952, Ford Foundations in 1970s, Dale Baker in 1997, have continued to contribute Turkish education system in different areas especially in science and technology education.

In the United States, the National Science Education Standards (National Research Council, 1996), one of the most important reforms in science education, declared that science is for everyone and its purpose is to prepare students to be scientifically literate citizens. These science education standards greatly influenced the Turkish educational system and recent science and technology curriculum (MEB, 2005) in Turkey. American science curriculum based on standards was taken as a model.

In addition to the changes occurring within Turkey (both curriculum and instruction) many Turkish master and doctoral students have been sent to study in modern countries within the National Educational Development Project (NEDP), which has been supported by the World Bank since 1993. Since 1997, 689 students have been sent to the United States. Currently 25 of 247 Turkish students in the United States are studying in the field of science education in graduate colleges in various universities, which are ranked as top schools in their country (General Directorate for Higher Education (Universities in Turkey), http://yogm.meb.gov.tr/Resmiburslular.htm). It can be concluded that Turkish and American education systems have a strong link from past to today.

In this study, "The Relevance of Science Education" (ROSE) survey was selected for comparing students' opinions about science and technology because of appropriateness for international comparisons. ROSE and international comparative project meant to shield light on effective factors of importance to the learning of science and technology. About 40 countries such as England, Norway, Ireland, Japan, Sweden, Israel, South Africa, Russia, Uganda, Ghana, and Estonia have taken part in ROSE. Sjoberg and Schreiner (2005) stated that

> "We have tried to make an instrument that can be used in widely different cultures. The aim is to stimulate research cooperation and networking across cultural barriers and to promote and informed discussion on how to make science education more relevant and meaningful for learners in ways that respect gender differences and cultural diversity." (p. 2).

As mentioned above, during 1923, the date of foundation, Turkey has been influenced by the American educational system, especially in the dimension of education of science and technology, and restructured its educational system by taking American educational system as a model. Sjoberg and Schreiner (2005), as creators of ROSE, emphasized the main aim of the application of this international project as; to eliminate barriers by revealing cultural and gender similarities and dissimilarities and to create a common language. In this context, in the point where Turkish educational system has reached today by modeling American educational system, the aim of this study is to reveal the thoughts of students on science and technology and to determine the similarities and dissimilarities.

2. Method

2.1. The instrument

The instrument used in this study, ROSE (the Relevance of Science Education) is an international survey aimed at examining the influence of different factors in science and technology learning, and more than 40 nations are participating worldwide (Schreiner & Sjøberg, 2004). The ROSE study comprised different aims: on the one hand, to gain empirical insights to stimulate a critical discussion of existing science instruction on a national and international level; and on the other, to illustrate potential approaches that could increase the relevancy, attractiveness and quality of science teaching (Elster, 2007).

As cited in Elster (2007), The ROSE questionnaire is based on experience gained from the international SAS-study Science and Scientists (Sjøberg, 2000), Eurobarometer 55.2 (EU, 2001) and the National Science Board (NSF, 2004). It was validated and optimised in national and international preliminary studies, taking different cultural contexts into consideration. Also, an international advisory group has been established to serve as main partners in the development of the ROSE instruments. Face validity was established with the review of the instrument by an international panel and subsequent field testing in three countries. ROSE involves a wide range of countries from all continents. Key international research institutions and individuals work jointly on the development of theoretical perspectives, research instruments, data collection and analysis (Schreiner & Sjøberg, 2004). The ROSE questionnaire consists of 250 closed items with four step rating scales as well as an open question. The questionnaire is divided into seven sections:

- What I would like to learn about
- My future job
- Attitudes to environmental problems
- Attitudes to science lessons
- Opinions on science and technology
- Out-of-school- experience
- 'What I would do as a scientific researcher' (open question)

In many international studies, these subtests have been treated as independent subheadings and have been worked on (e.g., Elster, 2007; Jenkins, 2006; Jenkins & Nelson, 2005; Krapp & Prenzel, 2011). In the present article, attention is focused on students' views about their experience of science at schools in in Turkey and the United States. Thus, "My opinions about science and technology" (question G) subtest was used to probe different aspects of how the students perceive the role and function of science and technology in society. Under the heading, the following instructions are given:

To what extent do you agree with the following statements? (Give your answer with a tick on each line. If you do not understand, leave the line blank.)

This is followed by 16 statements, each with a 4-point Likert scale from Disagree (coded 1) to Agree (coded 4). Missing responses were coded 9 (Schreiner, 2006).

In this study, for the American students, the ROSE questionnaire in English was used. For Turkish student, it was translated into Turkish by English, Turkish and Science educators. In the Turkish edition, after the original version had been translated from English to Turkish by one of the researchers and science educators checked all items on the questionnaire for content validity in accordance with Turkish science curricula. Secondly, the Turkish version was controlled by a Turkish specialist. Thirdly, an English specialist checked the translation version. Fourthly, Turkish specialist checked the translated text for Turkish grammar. Fifthly, Turkish version written after the grammar check was again translated into English. Finally, original ROSE questionnaire was compared with translated English version by the English specialist. Researchers concluded the translation was completed accurately. It was piloted in two Turkish school classes and the elements validated for comprehensibility in school interviews. Then, researchers applied final version of the survey in Turkish to Turkish students. The students were allotted one school class to answer the questionnaire.

2.2. Subjects

In this study context, purposive sampling was selected which is one of the three non-probability samplings commonly used in quantitative research. As the name implies, purposeful sampling involves the researcher's selecting subjects based on their perception of the characteristics of those subjects. Returning to our study, one intact school was selected from each country with similar features including social-economic status, learning environment, teachers' background, curriculum, and teaching methods- in the United States, curriculum was developed by the school district and schools based on federal and state standard, so the selected school in the United States for the sample has the most appropriate curriculum for the Turkish school science curriculum. The number of participants from each country is different because of school / class size. School size in both countries is determined by the education laws and special conditions of the countries.

For Turkish sample, application permission was taken from Ministry of Education, Department of Research, Planning and Coordination (Formal Document Number: B.08.0.APK.0.03.05.01-01/1026). For American sample, application permission was taken from Texas tech. University Protection of Human Subjects Committee.

Following the permission, questionnaires were applied on Turkish and American sample. In actual, the ROSE project target population is the cohort of all 11-13-year-old pupils in the both countries, or the grade level where most 11-13 year old pupils are likely to go in Turkey, these pupils attend primary school (grades 6-8) in Ankara. In the United States, these pupils attend elementary and middle school or junior high school in Lubbock, TX. In total, 479 students participated in this study. Of the 479 students who completed questionnaires in both countries, 116 were American students and 363 Turkish students. 53 were girls and 63 were boys in American sample, 202 were girls and 161 were boys in Turkish sample. One intact school was assigned randomly for this study from each country. Thus, the number of the students is different.

In many countries, middle school is the last opportunity for students to relate to science and technology in any organized framework. It is also the period when students decide whether to take science and technology as a major subject at high school level or to stop learning these subjects. Therefore, it is necessary to promote the development of positive attitudes towards science and technology at this critical time (Scherz & Oren, 2006).

3. Results

The Turkish and American students' responses and the median values to the 16 statements about science and technology are given in Table 1. The "agreement index" in Table 2 represents the difference in the percentage of agree / low agree and disagree / low disagree Turkish and American students' repossesses to each item. Table 3 summarizes the responses to the sixteen statements by culture. In Table 3, chi-square values were computed only over agree and disagree ratios, KS values were computed over all values.

Table 1. *Distributions of Turkish and American students' responses to "my opinion about science and technology" (American students' responses in brackets)*

Statement No.	Disagree %	Low disagree %	Low Agree %	Agree %	Nil Response*	Median (Turkey)	Median (USA)
1	7.2 (2.6)	8.0 (10.3)	13.8 (26.6)	71.1(57.8)	0.9	Agree	Agree
2	5.2(2.6)	12.7(8.6)	27.0(29.3)	55.1(58.6)	0.9	Agree	Agree
3	8.3(3.4)	19.6(11.2)	17.9(36.2)	54.3(48.3)	-	Agree	L.Agree
4	11.6(6.0)	16.8(20.7)	21.2(26.7)	50.4(46.6)	-	Agree	L.Agree

5	8.3(12.1)	20.9(11.2)	22.9(33.6)	47.942.2)	0.9	L.Agree	L.Agree
6	7.4(12.1)	27.5(27.6)	21.8(35.3)	43.3(23.3)	1.7	L.Agree	L.Agree
7	11.6(23.3)	20.4(30.2)	27.8(31.0)	40.2(12.0)	2.6	L.Agree	L.Disagree
8	9.9(38.8)	26.4(31.9)	26.4(18.1)	37.2(11.2)	-	L.Agree	L.Disagree
9	18.5(46.6)	28.9(22.4)	25.3(22.4)	27.3(8.6)	-	L.Agree	L.Disagree
10	22.9(28.4)	30.0(33.6)	23.1(19.8)	24.0(16.4)	1.7	L.Disagree	L.Disagree
11	11.0(19.0)	22.0(18.1)	21.8(32.8)	45.2(28.4)	1.7	L.Agree	L.Agree
12	17.9(23.3)	20.9(25.9)	28.4(24.1)	32.8(22.4)	4.3	L.Agree	L.Disagree
13	10.5(39.7)	20.1(29.3)	27.5(17.2)	41.9(13.8)	-	L.Agree	L.Disagree
14	20.9(60.3)	30.9(25.9)	25.3(5.2)	22.9(6.0)	2.6	L.Disagree	Disagree
15	12.9(22.4)	28.4(38.8)	24.5(25.0)	34.2(12.1)	1.7	L.Disagree	L.Disagree
16	14.9(7.8)	20.7(10.3)	25.3(36.2)	39.1(45.7)	-	L.Disagree	L.Agree

Only for the United States (USA) sample

Table 2. *Degree of agreement with statements about science and technology*

Statement	Agreement Index* (TR)	Agreement Index* (USA)
1. Science and technology are important for society.	+69.7	+70.8
2. Science and technology will find cures to diseases such as HIV/AIDS cancer, etc.	+64.2	+76.7
3. Thanks to science and technology, there will be greater opportunities for future generations.	+44.3	+70.4
4. Science and technology make our lives healthier, easier and more comfortable.	+43.2	+46.6
5. New technologies will make work more interesting.	+41.6	+52.5
6. The benefits of science are greater than the harmful effects it could have.	+30.2	+18.9
7. Science and technology will help to eradicate poverty and famine in the world.	+36.0	-9.6
8. Science and technology can solve nearly all problems.	+27.3	-41.4
9. Science and technology are helping the poor.	+5.2	-38.0
10. Science and technology are the cause of the environmental problems.	-5.8	-25.8
11. A country needs science and technology to become developed.	+34.0	+24.1
12. Science and technology benefit mainly the developed countries.	+22.4	-2.7

13. Scientists follow the scientific method that always leads them to correct answers.	+38.8	-11
14. We should always trust what scientists have to say.	-3.6	-75.0
15. Scientists are neutral and objective.	+17.4	-24.1
16. Scientific theories develop and change all the time.	+28.8	+63.8

*Agreement Index= (agree+ low agree)-(disagree+ low disagree)

Many of the cultural differences in Table 3 are statistically significant. In general, American students express less confidence and lower levels of optimism than Turkish students in their responses to the 16 statements, although the differences are not great.

Table 3. *Survey country differences in response to "my opinions about science and technology"*

	Turkey		USA			
Statement No.	Agree %	Disagree %	Agree %	Disagree %	Chi-Square*	KS
1	84.8	15.2	85.3	14.7	NS	0.089
2	82.1	17.9	87.9	12.1	NS	NS
3	**72.2**	**27.8**	**85.2**	**14.8**	**0.007**	NS
4	71.6	28.4	73.3	26.7	NS	NS
5	70.8	29.2	76.5	23.5	NS	NS
6	65.0	35.0	59.6	40.4	NS	0.002
7	**68.0**	**32.0**	**45.1**	**54.9**	**0.000**	0.000
8	**63.6**	**36.4**	**28.7**	**71.3**	**0.000**	0.000
9	**52.6**	**47.4**	**31.0**	**69.0**	**0.000**	0.000
10	**47.1**	**52.9**	**36.8**	**63.2**	**0.069**	NS
11	66.9	33.1	62.3	37.7	NS	0.015
12	**61.2**	**38.8**	**48.6**	**51.4**	**0.026**	0.047
13	**69.4**	**30.6**	**31.0**	**69.0**	**0.000**	0.000
14	**48.2**	**51.8**	**11.5**	**88.8**	**0.000**	0.000
15	**58.7**	**41.3**	**37.7**	**62.3**	**0.000**	0.000
16	**64.5**	**35.5**	**81.9**	**18.1**	**0.001**	0.000

*Chi-square has been used to compare agree/disagree using 2x2 tables.

The data in tables 1-3 present a number of positive messages about the students' views about science and technology. For example, both Turkish and American students, there is a large degree of agreement that science and technology are important for society (Statement 1), there is optimism about the contribution that they can make to curing diseases as HIV/AIDS and cancer (Statement 2). Science and technology are also seen as creating greater opportunities for future generations (Statement 3), as making everyday life healthier, easier and more comfortable (statement 4), and new technologies will make work more interesting (statement 5). In addition, for American students, there is large degree of agreement that scientific theories develop and change all the time (Statement 16). For this statement, there is a lower level of agreement among Turkish students. For example; both for Turkish and American samples; while there is a significant agreement for the items 1-5, American sampling additionally presents a high agreement for the item 16. Turkish sample presents a low agreement for the item number 16. With the agreement on the items 10 and 14 in the Turkish sample; the disagreement in American sample exists for the items 7- 15. American (36.8%) and Turkish (47.1%) students agree on the idea that science and technology define the reason of the environmental problems. The agreement percentage for the most of scientists to tell the truth all the time was 48.2% for Turkish students and 11.5% for American students.

Besides, for the American sample, the items; science and technology will help eradicate poverty and famine in the world (agree: 45.1%, disagree: 54.9%), science and technology can solve nearly all problems (agree: 28. 7%; disagree: 71.3%) , science and technology are helping the poor (agree: 31%; disagree: 69%) , science and technology benefit mainly the developed countries (agree: 48.6%; disagree: 51.4%), scientist follow the scientific method that always leads them to correct answers (agree: 31,0%; disagree: 69%) scientist are neutral and objective (agree: 37.7%; disagree: 62.3%) have higher disagreement rates. For the Turkish sample, the social benefits of science and technology, given in the Table 4, Turkish students are optimistic (items 2, 4 and 6) on the issue that science and technology contribute to the treatment of illnesses like HIV/AIDS or cancer; make everyday life healthier, easier and more comfortable; science has more benefits than its possible harms. In the United States sample of this component, it is seen that students display a high degree of confidence for science, scientists and scientific method. The results of factor analyses of the responses by culture are given in Table 4 and they reveal some differences in the clusters.

As seen Table 4, whereas 16 statements on ROSE survey were grouped in the three factors for Turkish sample, these statements were grouped six factors in American samples. The data in Table 4 suggest that while Turkish students who are more optimistic about the social benefits of about science and technology (statements 7- 9) they display lower degree confidence in science, scientists and scientific methods than American students (statements 13-15). Turkish students believe that science will help developing countries and advantaging the richer countries more than American students do (statement 11- 12).

Table 4. *Principal component analyses of "my opinions about science and technology for Turkish and (USA*)"*

Statements	Component 1	Component 2	Component 3	Component 4*	Component 5*	Component 6*
1. Science and technology are important for society.	**0.536**(-0.226)	0.266 (**0.635**)	-0.290(0.169)	0.145	-0.041	0.332
2. Science and technology will find cures to diseases such as HIV/AIDS cancer, etc.	**0.652** (0.123)	0.109 (**0.819**)	0.129 (0.074)	-0.018	-0.130	-0.056
3. Thanks to science and technology, there will be greater opportunities for future generations.	**0.598** (0.210)	0.266(**0.772**)	-0.290 (0.157)	0.049	0,204	0.014
4. Science and technology make our lives healthier, easier and more comfortable.	**0.74**(-0.011)	-0.065 (.419)	0.159 (**0.587**)	0.223	-0.080	-0.040
5. New technologies will make work more interesting.	**0.550** (0.131)	0.286 (0.154)	-0.087 (**0.734**)	-0.054	-0.053	-0.069
6. The benefits of science are greater than the harmful effects it could have.	**0.670**(-0.137)	-0.055(0.154)	0.210 (**0.768**)	0.044	-0,155	0,163
7. Science and technology will help to eradicate poverty and famine in the world.	0.229 (0.349)	**0.609** (0.217)	-0.138 (**0.494**)	0.229	0,362	0,227
8. Science and technology can solve nearly all problems.	**0.501** (0.344)	0.288(0.104)	0.207 (**0.477**)	0.056	0.042	-0,352
9. Science and technology are helping the poor.	0.044 (**0.474**)	**0.691** (0.153)	0.147 (0.013)	0.323	0.078	0.013
10. Science and technology are the cause of the environmental problems	0.068(-0.549)	0.021 (**0.019**)	0.731 (-0.164)	-0.011	**0,832**	-0.059
11. A country needs science and technology to become developed.	0.576 (0.242)	0.244 (0.261)	-0.080 (**0.085**)	**0.671**	-0,291	0,102
12. Science and technology benefit mainly the developed countries.	0.102 (**0.066**)	0.106 (-0.062)	0.692 (0.031)	**0.843**	0,127	-0.037
13. Scientists follow the scientific method that always leads them to correct answers.	0.375 (**0.671**)	**0.481** (0.187)	-0.171 (0.031)	0.131	-0,323	-0,138
14. We should always trust what scientists have to say.	-0.086 (**0.805**)	**0.570** (-0.030)	0.434 (0.058)	0.114	-0.077	0.095
15. Scientists are neutral and objective	0.243 (**0.608**)	**0.550** (-0.050)	0.198 (0.058)	-0.107	0,257	0,310
16. Scientific theories develop and change all the time.	0.461 (**0.187**)	0.255 (0.091)	0.160 (0.014)	0.029	-0.038	**0,856**

*Extraction Method: Principal Component Analysis

Rotation method: Varimax with Kaiser Normalization, significant factors in bold

4. Discussion

There are significant social and economic differences between developed and developing countries namely the United States and Turkey. Many of the underlying causes of these differences are rooted in the long history of development of such nations and include social, cultural and economic variables, historical and political elements, international relations, geographical factors. These, however, do not tell the whole story. The differences in the scientific and technological infrastructure and in the popularization of science and technology in the two groups of countries are the most important causes of differential social and economic levels. An essential prerequisite to a country's scientific and technological progress is early recognition of the necessity of a good educational system.

The responses presented in Tables 1 and 2 may also be compared with data from other studies such as Eurobarometer by administrated European Union and Science and Engineering Indicators by administrated National Science Foundation. The Eurobarometer conducted with in the 32 countries, 25 member states of the European Union and the candidate countries including Turkey and the members of the European Free Trade Association. The Eurobarometer data are derived from a total of 32,897 comprising age 15 and 50+, face to face interviews, based upon specific questions (European Commission, 2005). The Science and Engineering Indicators conducted on American people from elementary level to older all age level. Indicators are quantitative representations that might reasonably be thought to provide summarizing information bearing on the scope, quality and vitality of the science and engineering enterprise.

As earlier mentioned above many of the statements on ROSE survey are copies of questions used in large scale public surveys like the Eurobarometer and similar surveys in other parts of the world. Thus, a few of the statements in the ROSE study are similar to Eurobarometer and Science and Engineering Indicators. Although direct comparison of the findings from the three sources is not straightforward because of differences in sampling methodology and of the way in which the findings are presented.

Eurobarometer survey shows that most Turkish (76%) are optimistic that scientific and technological progress will help to cure illnesses such as AIDS and cancer and that science and technology will make our lives healthier, easier and more comfortable (75%). Sixty-six percent agree that, thanks to science and technology there will be more opportunities for future generations and, sixty-two percent believe that science and technology can sort out any problem and sixty-three percent also agree that the application of science and new technologies will make peoples' work more interesting. Only a small majority, 58% believe that the benefits of science are greater than any harmful effects it may have and 51% of the respondents agree that science and technology will help eliminate poverty and hunger around the world. In addition, forty-three percent agree that the benefits of science are greater than the harmful effects it may have.

This percentage can be compared with the agreement indices and median positions identified in Tables 1 and 2 in response to statements 2-8 are respectively. As seen Table 1 and 2, these results are similar to ROSE results for Turkish sample.

The National Science Foundation in the United States released Science and Engineering Indicators report in 2004 these Jenkins (2006) pointed out that generally supportive attitude towards science and technology reported in the ROSE and Eurobarometer surveys is also evident in the data collected by NSF although, in general, such support is stronger than Europe. Jenkins indicated based on these reports that more Americans (72%) than Europeans (52%) agreed in 2001 that the benefits of scientific research outweighed any harmful results. But, in this study, this result was not supported by the very similar statement. We find out in this study for this sample (See Table 1 and 2) more Turkish students (43%), if we accept to Turkish sample as a European representative, than American students (23%) agree that the benefits of science are greater than the harmful effects it could have.

As earlier paper; written by Jenkins (2006) drew upon the findings of the ROSE to report the English students' opinion about science and technology. Jenkins' study results are similar to our results. He found out a large degree of agreement for statement 1, 2, 3, 4 and 16, English students' opinion about science and technology is closer to only American students except of Turkish students for statements 3, 4, 7, 8, 9, 13, 16. For three samples, students' opinion percentage of agree median is similar for statements 2, 5, 6, 10, 11, 14, 15 (See Table 1). These results show that culture affects opinion about science and technology. English and American culture declared as the western culture in educational literature and there is a strong relation in historical, economic, social, and culture. As Jenkins (2006) determined in his study that the word science has different connotations in different countries and in some cases the academic disciplines are known by a different name from the school subject and science itself now embraces many disciplines from astrophysics to molecular biology and technology is also readily associated in popular usage with computers and mobile phones but not so readily with gas coolers, electric irons or simple tools. As a result of this approach, students' opinions are affected by their experience of the school versions and their family background and environment, their outdoor school experiences about science and technology and those opinions differ to varying degree.

In this study, as it can be seen in Table 4, sixteen statements existed in the test were assembled into groups in 3 factors for Turkish sample and 6 factors for American sample. Despite the similarities between the educational systems of both countries, the reason for this difference can be explained by the differences in cultural, historical, economical and, social life affecting students' view of science and technology. America is a multicultural nation and American educational system has a structure that takes multiculturalism into consideration. The emphasis on multiculturalism in educational programs and course books is noticeable. Schools serve those students from different cultures. Each of those students reflects their own backgrounds on educational system. When compared with Turkish educational system, American educational system, despite the similarities in content arrangements of programs, has some differences between the application of programs, organization of the class and school structures. From the aspects of the number of students in classes and schools and the opportunities of that the schools have, American educational system has more advantages. Today, Turkish educational system still deals with such problems such as centralist management system, anxiety for exams, the number of the students per a class or a school, and lack of teacher. In this context, on scientific and technological issues, rather than experiencing activities from the authentic resources, the students are trained in exam success focused educational system which is classical, teacher centered and based on course books.

Many scientists and scientific studies are American originated. Because of that, American students have more positive attitudes towards science, scientific method and scientists than Turkish students. This may be a factor that strengthens the feeling of belonging among American students towards scientific method and scientists. Despite some developments in scientific studies in recent years, Turkey is still far away from developed countries. For the fact that scientific studies arise from developed countries such as the United States, Turkish students think that scientific studies mostly benefit developed countries and contribute to their development.

Furthermore, as many studies from literature have revealed, a number of factors other than schools such as television programs, museums, and science centers affect students' views, attitudes, interests and images about science and technology. Television programs that are broadcasted in the United States and Turkey, the structural differences of museums and science centers make differences in the perceptions of students within these dimensions. National science centers such as NASA in the United States has been working in cooperation with universities, schools and students for a long time. These institutions prepare educational materials for teachers and students and organize seminars and tours. On the other hand, these types of activities are new for Turkey.

The factors defined above and others that cannot be defined such as level of income, family structure, and educational level of the parents affect student's opinions about science and technology. As a result of the factor analysis that has been carried out, these differences caused the factor loading to be different.

In spite of some limitations such as sample size in both countries, methodological issues including general limitations of any questionnaire based study and using Likert-type scale for scoring responses (e.g. Ary, Jacobs, & Razavieh, 1996; Cohen, Manion, & Morrison, 2000; Ray, 1980; Robson, 2002; Weng, 2004) and limited literature about comparative Turkish and American culture on this study scope, this study indicates that there is a relationship between culture and science and technology opinion. This result is similar with Jenkins' (2006) and Aikenhead & Otjusi's (2000) studies.

5. Implications

Implications for universal science and technology curricula

In contrast to comparative assessment studies such as the Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA), The Progress in International Reading Literacy Study (PIRLS); in the ROSE study students' attitudes and interests are compared, and experiences from the respective countries are taken into consideration. Information gathered from the students is used to orientate subjects better to student attitudes, needs, and interests. It is assumed that the lack of importance given to the affective domain is one of the fundamental problems for science curricula. Shulman and Tamir (1973) argued that the affective outcomes of science instruction are at least as important as their cognitive counterparts. In this context, this research offers an important perspective on the pupils' in Turkey and the United States perspective of school science education and their attitudes, reactions to their experience towards science.

Curriculum designers are faced with a real challenge if students say that they do not wish to learn about key foundational content. According to Howes (2002), science education reforms basically ignore the very people they are intended to benefit. How does curriculum design thinking intersect with the learning of science content? How should curriculum designers respond when the epistemic structure of the science teaching as a discipline and students' views and attitudes are in conflict? We do not have 'the definitive solution' but adapting the curriculum by adding topics that reflect students' attitudes, beliefs, and interests could be a very effective means of solving some of the current problems of school science education.

Should students have a say in their science course content? Should students be allowed to choose school science topics themselves? Armstrong's (1973) recommendation that students should be allowed to choose learning topics in school science. In this context, we agree with him. Also, we clearly need to make the curriculum as relevant and as motivating to the students as possible. According to Armstrong, the interest shown by students in different subject matter should count in the pedagogical thinking of those planning curricula in schools. Teachers should notice carefully students' beliefs, attitudes, choices, and preferences in setting goals, content and learning methods. Science educators should look for a permanent path of interaction to discover which topics their students want to study in addition to the formal curriculum. Perhaps the most powerful message to emerge from this study is the need to concentrate on ways to develop students' affective response so they find personal satisfaction in doing science and therefore want to continue with it. We know based on science education literature that a negative attitude toward science leads to lack of interest, and when science subjects can be selected to avoiding the course. Furthermore, a positive attitude to science leads to a positive commitment to science that influences lifelong interest and learning in science, also for the scientific literacy of future generations.

This article briefly locates the American and Turkish science and technology curricula in this context of school science and technology education. It reports analyses of students' attitudes towards school science in Turkey and the United States. These explore curriculum development and implementation, strengths, and weaknesses of the science curriculum in both countries, and missed and realized opportunities. This leads to a conclusion that describes alternative future school science and technology curricula design.

As explained SAS-study Science and Scientists (Sjøberg, 2000) Report, the profile of the attitudes, reactions, experiences and interests does, however, vary strongly between countries. This fact should call for caution when it comes to "importing" foreign curricula and scepticism against the pressure to "harmonise" science curricula to become similar across the globe. Although science per se may be universal (A debate that is not pursued in this article context.), school science curricula for students should reflect need and priorities in each country. Data obtained from such projects like this may provide a basis for deliberations about curricular priorities. Consequently, curriculum designers, policy makers and academicians should be encouraged to determine the learners' interests and to relate these interests to subject matter to provide a base for new knowledge and skills. The interest learners show in terms of key ideas should contribute to the pedagogical thinking of those who plan curricula for the learners.

Implications for research in universal school science and technology education

In light of the results of this study, we suggest that although the ROSE instrument is not focused school science and technology subjects, this instrument will provide information about some elements related to science education such as experiences, interests, attitudes, reasons of career choosing. Today, these elements are part of science and technology education research agenda. Therefore, ROSE instrument and ROSE study results are attracted attention by science education researchers. We believe that our study will be used by researchers studying and focusing on international science education. Furthermore, we recommend carrying out the ROSE instrument on a larger sample, more countries and varied designs will help to define an optimal model or framework for universal science and technology education for age 11-13 years.

This study showed us that; comparing one nation's content arrangement with another country makes no similarity among learning results. For that reason, taking only the topics, principles and visions of a successful country in the studies of program development in the field of science and technology and transferring it, is not sufficient in taking a country as a sample. Every country has its own structure. The educational models and taken samples should overlap the structure and opportunities of the country or should be reorganized by considering the realities of the country. Because of that, in international comparison studies, an evaluation should be carried out considering students' socio-economical levels, out-of-school activities, real life experiences of science and technology, and school and class activities.

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