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LEBANESE STUDENTS' CONCEPTIONS OF AND ATTITUDES TOWARDS SCIENCE AND RELATED CAREERS BASED ON THEIR GENDER AND RELIGIOUS AFFILIATIONS

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ABSTRACT. Students' attitudes and conceptions seem to be influenced by social/cultural contexts and interactions with other students from diverse backgrounds. Therefore, educators need to study attitudes, conceptions, and career choices in relation to diversity indicators. Such was one focus of the Science Education for Diversity project, which involved collaboration among UK, The Netherlands, Turkey, Lebanon, India, and Malaysia. The purpose of this component of the project was to investigate Lebanese students' attitudes, conceptions, and career choices in relation to gender and religion. The 1,260 Grade 4 to 8 participants, who came from co-educational private and public schools, purposefully selected to include different religions, filled out a questionnaire designed specifically for the Project. Results from the Lebanon data showed that students generally had positive attitudes towards science. They seemed to identify only things they study about in school as "science" with some gender differences but no differences based on religion. Students seemed to be worried about environmental socioscientific issues. About 40 % of students believed that God created all life and that their families believed that too, with significant differences by gender and religion. Finally, the greater majority stated that they would like a job that ensures recognition and respect. Implications related to maintaining students' interest in science and science-related careers were discussed.

KEYWORDS: attitudes, conceptions, diversity factors, science

The study aimed to explore relationships between Lebanese students' attitudes toward science, conceptions about science and socioscientific issues, and their conceptions about career choices on one hand, and their gender and religious affiliations on the other hand. The data used in this study come from the Science Education for Diversity (SED) project,[1] a collaborative project between universities from the UK, The Netherlands, Turkey, Lebanon, India, and Malaysia. The SED project is a response to the decline in student attitudes towards science and the weakened interest in science in Europe. Thus, the overall aim of the SED project was to respond more effectively to the cultural diversity of students in order to improve science education in Europe and other countries, and one way towards achieving that was to investigate, in collaboration with international partners in countries, where science remains a popular career choice, reasons for the popularity of science, and factors that contribute to this popularity. Selection of the countries to participate in

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the study was based on the interest in science in these countries. Consequently, the UK and The Netherlands were selected because interest in science at the middle school level and beyond is relatively low, students seem to have negative attitudes toward science, and many students do not select science-related careers. Conversely, students in the remaining four countries (India, Lebanon, Malaysia, and Turkey) seem to be interested in science at all educational levels. This paper focuses on the case of Lebanon by investigating the relationship among different variables in the Lebanese context. The following background section describes and discusses what is known about the relationships between the different variables and what has been found in previous studies about those relationships.

Background

The twenty-first century requires today's students to be scientifically and technologically literate in a world that is vastly dominated by science and technology. Such a universal need necessitates major educational reforms concerning the ways schools organize their work (Resnick, 2010). Resnick called for the development of career and college readiness skills that equip students with the appropriate twenty-first century skills and expertise, skills that should be acquired by all students irrespective of their gender, socio-economic status, ethnicity, and religion. Important factors that determine whether or not students develop the skills necessary to live and work successfully in the twenty-first century are their attitudes toward and conceptions about science.

Interest in and Attitudes Toward Science

A growing body of research initiated in Europe and North America has shown that most students develop their interest in and attitudes towards school science before the age of 14 years (Osborne & Dillon, 2008). According to a longitudinal study by Tai, Liu, Maltese & Fan (2006), early elementary experiences (before eighth grade) may be crucial in shaping the career expectations of adolescents. And by age 14 years, it was found that students who expected to pursue science-related careers were 3.4 times more likely to achieve a physical science or engineering degree than students without similar expectations. Along similar lines, Sjøberg & Schreiner (2010) noted that the (1) attitudes to science and technology among adults and young people are mainly positive, (2) young people are more ambivalent and skeptical about science than the adult population in the richest countries (Northern Europe, Japan), and (3)

there is growing gender difference particularly in the richest countries, with girls being more negative (or skeptical) than boys.

Attitude is a very complex concept that integrates multiple properties and different domains (Zhang & Campbell 2011). Generally, it refers to the feelings or preferences that individuals have about an object, whether positive or negative, based on their beliefs about the object (Allichin, 1999; Kind, Jones & Barmby, 2007; Kususanto, Fui & Lan, 2012; Oluwatelure & Oloruntegbe, 2010; Salta & Tzougraki, 2004). Klopfer (1976) conceptualized the term 'attitude toward science' by developing six categories of different aims or orientations: manifestation of favorable attitudes toward science and scientists; acceptance of scientific inquiry as a way of thinking; adoption of scientific attitudes; enjoyment of science learning experiences; development of interest in science and science-related activities; and development of interest in pursuing a career in science. More recently, Kind et al. (2007) claimed that attitudes toward science can be measured based on seven constructs: (1) learning science in school, (2) practical work in science, (3) science outside of school, (4) importance of science, (5) self-concept in science, (6) future participation in science, and (7) combined interest in science. At another level, Osborne, Simon & Collins (2003) maintained that several factors could influence the attitudes toward science such as: perception of the science teacher; anxiety towards science; value of science; self-esteem of students in relation to science; motivation towards science; enjoyment of science; attitudes of peers and friends towards science; attitudes of parents towards science; nature of the classroom environment; achievement in science; and fear of failure on course. In the context of this paper, attitudes refer to interest in science and science-related activities, feelings that students have about science, enjoyment of science learning experiences based on their beliefs and preferences, as well as the beliefs and preferences of their peers.

Conceptions of Science

It is important to understand students' conceptions about science and science learning as it will help science educators develop learning opportunities that can promote more informed beliefs and greater conceptual understanding of science topics (Davis, 2003). In this paper, students' conceptions or beliefs do not represent their conceptual understanding of science topics, but they rather refer to their ideas about what science is like as a field, what counts as science, how one does science, and how one learns science (Davis, 2003).

Attitudes and conceptions are greatly influenced by the content, structure, and the mode of delivery of school science curricula. For example, a recent report on science education in Europe (Osborne & Dillon, 2008) points to the similarity of almost all science curricula in Europe. This finding is also confirmed in research outside Europe (e.g. BouJaoude, 2003). The science curricula have a general model of starting with the teaching of basic concepts that are returned to later in more depth. This dominance of a pedagogy of transmission and copying (BouJaoude, 2003; Osborne & Dillon, 2008) offers few links to real life science, such as socioscientific and career issues, resulting in a lack of relevance to students' real-world context.

Students' attitudes and conceptions also seem to be influenced by their social/cultural contexts as well as their interactions with other students from diverse backgrounds in a given classroom (Lemke, 2001). Consequently, it is essential that educators consider diversity in the science classroom and understand students' social and individual needs, since learning takes place in a social/cultural context as stipulated by the social constructivist perspective which focuses on understanding the interaction of social and individual processes that facilitate knowledge construction (Palincsar, 1998). Researchers have therefore attempted to investigate the relationships between various diversity indicators such as gender, ethnicity, religion, and special needs of students and their attitudes toward and interest in science as well as their career choice (Haste, 2004; Roberts, 2002).

Issues of Diversity

Research results regarding the level of girls' interest in science and science careers vary considerably and may be influenced by the way the questions used in survey instruments or interviews are phrased. For example, Haste (2004) found that about a third of both boys and girls (age 11–21 years) 'would be interested in a job related to science.' However, when the question addressed to 14–15-year-old was phrased as 'I would be interested in a job related to science or engineering,' the result was positive for 67 % of boys and 49 % of girls (Haste, Muldoon, Hogan & Brosnan, 2008). Interest in technology seemed to be more gendered; in 2004, 63 % of males and 37 % of females agreed with the statement 'I like learning about new developments in technology'; in 2007, the figures were 81 % and 54 %. The data from both Haste (2004) and Haste et al. (2008) also suggest that girls are interested in science topics that are different from those that interest boys. For example, while boys are more

interested in space research and science fiction, girls are more interested in health issues. These data imply a gendered orientation towards science, and thus, science ought to be explored in relation to gender. It is not that girls have negative orientations toward science; they just bring different values to their interest in science as shown in a previous study by Osborne & Collins (2001) that focused on the views of age 16 years British science students. The views were captured through focus groups that were organized along two dimensions: male versus female and scientific versus non-scientific orientation. Students viewed scientific knowledge as being an important component of their education. However, the reasons given by the students were more clearly articulated by the girls than the boys.

At the same time, science, engineering, and technology also appeal differently to different genders and cultural groupings. Haste (2004) noted how young women in the UK enroll dominantly in university courses of biology but rarely in university physics and mechanical engineering classes. Haste (1994) explored the feminist scholarship over three decades and discussed what has been referred to as the 'masculinity' of science and its overlap with models of 'rationality' and models of science. Along these lines, Haste (2004) and Haste et al. (2008) argues that girls and young women, compared with males, (a) desire to integrate ethical issues with science, (b) do not consider a scientific way of knowing as being widely applicable to problems, (c) do not necessarily demand clear answers to problems, and (d) are more tolerant of ambiguity.

At a time when all students need to be scientifically literate, research has shown a decline in students' selection of science-related careers and attitudes toward and interest in science (Baram-Tsabari & Kaadni, 2009; Sjøberg & Schreiner, 2005). Weinburgh (1995) conducted a meta-analysis covering the literature between 1970 and 1991 that examined gender differences in student attitudes toward science. Results of the analysis of gender differences in attitude as a function of science type indicated that boys show a more positive attitude toward science than girls in all types of science. In this regard, the Relevance of Science Education (ROSE) project (Sjøberg & Schreiner, 2005) showed that young people in European countries are not opting to pursue careers in science with girls being more negative toward science than boys. Another study, *Science in My Future* (Haste, 2004) showed that students in the UK can be categorized into four groups: the "Greens" who are interested in environmental issues, "Techno-investors" who are enthusiastic about the potential of science, the "Science oriented" dedicated to science as a way of thinking, and the 'Alienated from science' dominated by females.

Other projects that attempted to address issues of diversity and science education is the Science Education for Diversity project that investigated science education diversity in six countries in Europe and Asia, including Lebanon.

Case of Lebanon

Attitudes Toward Science. Research about attitudes toward science conducted in Lebanon has been scarce (BouJaoude, Abd-El-Khalick & El-Hage, 2009). Two studies focused on investigating students' attitudes toward science at the elementary, middle, and high school levels. In the first study, Raad (1997) investigated gender differences among secondary school students' emotional and intellectual attitudes toward science. Results showed no significant differences between males and females on emotional and intellectual attitudes toward science across grade levels. However, the author noted that (a) more females than males enrolled in the literary rather than scientific sections in schools and (b) more males than females were interested in pursuing science-related majors in college. Accordingly, the author attributed these differences to social expectations and parental pressures in Lebanon. In the second study, Nokari (1998) assessed student attitudes toward science at the elementary, intermediate, and secondary school levels in Beirut in relation to some variables including gender. Results showed that more positive attitudes toward science were associated with studying science in the mother tongue (Arabic). Results also showed that males and high achievers had more positive attitudes than females and low achievers, respectively, and that attitudes toward science became less positive as students moved from the elementary to secondary level.

Career Choice and Gender. According to the United Nations Children's Fund (UNICEF 2010), adult literacy rates of females in Lebanon has increased from 82.2 % in 2003 to 92 % in 2008. However, while recent statistics show that almost equal percentages of students enroll in science and non-science streams at the secondary education level (48 % in the science stream versus 52 % in non-science streams), there exist gender differences: Females make up 62 % of non-science stream students and 48 % of science stream students (Center for Educational Research and Development [CERD], 2008). In higher education, 55 % of university students are females with approximately 38 % of females as compared with 20 % of males opting to major in humanities and social and behavioral science. As such, it is important to explore the issue of career choice as it relates to gender.

Religion. Religion is another angle from which diversity could be investigated in Lebanon. The country includes 18 Muslim and Christian religious sects with a majority of 60 % of Muslims. Additionally, the Lebanese constitution provides freedoms for these sects to establish and run their own educational institutions (Lebanon Const. art. X, § 2). The religious diversity and the freedoms provided to religious sects in education have had an effect on the content of the Lebanese science curriculum. Consequently, topics such as sex education and evolution are not included in the curriculum, even though they might be taught in some private schools. Recent research on conceptions of evolution in Lebanon has shown that university students' conceptions of evolution are influenced by their religious affiliations (Dagher & BouJaoude, 1997). Similarly, in a study conducted in Lebanon and Egypt, BouJaoude & Kamel (2009a) found that secondary-level students' conceptions about evolution were influenced by their religiosity and religious affiliations. Understanding of diversity issues and their relationships to science education in Lebanon's multi-cultural/multi-religious society has the potential to enhance our understanding of how to handle these matters effectively.

Rationale and Purpose

Evidence from the literature suggests that gender and religion are influential diversity factors affecting attitudes, conceptions, and career choices. However, very little research has been done in Lebanon, a multi-religious country, in the area of attitudes toward science and career choices. Moreover, the research in the area of religious diversity in Lebanon has been mostly conducted with the secondary students and in a specific area, specifically evolution. Understanding diversity factors in the Lebanese context might shed light on the effect of these factors on students' attitudes and career choices leading to increased participation in science in all sectors of society. Additionally, results of this study might help provide other multi-religious societies with insights about identifying and addressing similar issues. Consequently, the purpose of this study was to explore the relationships between gender and religious affiliations of Grades 4 to 8 Lebanese students and their attitudes toward science, conceptions about science and socioscientific issues, and their conceptions about career choices. Specifically, the study addressed the following questions: (1) What are Lebanese students' attitudes towards science, and how do these attitudes relate to their gender and their religious affiliations. (2) What are Lebanese students' conceptions about science

and about socioscientific issues (environmental issues and evolution), and how do they relate to their gender and religious affiliations? and (3) What are Lebanese students' conceptions about their career choices, and how do they relate to gender and religious affiliations?

Method

Participants

Participants in this study came from three private and three public co-educational schools. The schools (private and public) were purposefully selected based on five criteria: (a) having low or middle socio-economic status, (b) having an overall "acceptable" academic performance, (c) enrolling students from different religious group, (d) are co-educational, and (e) having English as the language of science instruction. A total of 1,260 Grade 4 to 8 students (ages ranging from 9 to 15 years, 51 % males and 49 % females) participated in this study. These grade levels were selected because most children develop their attitudes toward science between the ages of 10 and 14 years (Tai et al. 2006). As noted earlier, this study was part of a larger research project that investigated 10 to 14-year-old students' attitudes, conceptions, and career choices in relation to gender and religion in six different countries.

Instrument

The instrument used in this study was a questionnaire entitled "You and the World around You II Questionnaire" that was developed and validated by a team of researchers from the six countries that participated in the Science Education for Diversity Project. Piloting of the questionnaire in two Lebanese schools further established the validity of the instrument, which was adjusted based on the feedback from the pilot to insure the appropriateness for Lebanese students. The questionnaire consisted of nine sections each of which included several questions. Examples of the items used in the *You and The World around You II* questionnaire are included in the Appendix. The aim of the questionnaire was to elicit values related to cultural and ethnic diversities as well as attitudes toward and beliefs about science. The items were 'stand-alone' so that patterns and relationships between items can be explored in the analysis.

The items were drawn from a range of sources, including other related work such as the ROSE project (Sjøberg & Schreiner, 2005), but they

have also been devised on the basis of exploratory questions generated for the purposes of the study. Questions included definitions of what science is and who scientists are, areas of gender and religious differences regarding science within the Lebanese culture, conflicts of religion and science, and current environmental and ethical matters. Students filled out the questionnaires during two class periods and were asked not to discuss the questions with each other. A researcher was present in class to help the students and answer their questions.

Data Analysis

Data from the questionnaires were analyzed by using SPSS. In most cases, individual items from the different scales of the questionnaire were selected for analysis as the questionnaire was designed to allow for such selection. The items were related to students' attitudes toward science, student's opinions about the activities that are considered science, students' conceptions about environmental issues, and students' reasons for choosing a particular occupation. Frequencies and percentages of responses were computed for the entire sample, as well as by gender and religious affiliation (represented as Muslims and Christians). Furthermore, Chi-square was used to test for significant differences between the different variables. The decision to use Chi-square was based on the fact that all data were categorical in nature, and therefore, calculating measures of central tendency such as means would not provide meaningful results.

Results

The first section of the questionnaire required students to fill in their gender, age, school class, religious affiliation, and ethnicities. Table 1

TABLE 1

Religions that students adhered to

Religion[a]	*Frequency*	*%*
Christian	204	16.3
Muslim	689	55
Druze	235	18.7
No religion	5	0.5
I don't want to answer/I don't know	120	9.5

[a]Based on the completed questionnaires

TABLE 2

Ethnicities that students self-identified with

Ethnicity[a]	*Frequency*	*%*
Lebanese/other	1,122	90.1
Armenian	26	2.1
Palestinian	20	1.6
Syrian	47	3.8
Kurdish	30	2.4

[a]Based on the completed questionnaires

shows the religious affiliation of the students while Table 2 presents their ethnicities.

To answer the first research question, the attitudes towards science were conceptualized as (a) the attitudes of students themselves towards science and (b) their attitudes towards their peers who like science. Table 3 presents the results regarding attitudes toward science and shows that about 40 % of students like all science lessons with only a small percentage reporting that they did not like any science lessons. Table 4 presents the results regarding peers who like science and shows that the majority of students agree a little or a lot with the statement which asserts that other students who like science are very intelligent, and are interesting to talk to. In addition, almost half the students say that other students who like science make friends easily or are 'cool.'

It is also important to note that a small percentage of students said that they did not like science because it ignores feelings and people, or because it is too hard. Additionally, a majority of students said that they liked science because it provides clear answers and is not hard to study. No significant differences were found between males and females in

TABLE 3

Percentages of students' attitudes toward science

Statement	*Very true,%*	*A bit true, %*	*Not true, %*
I like all science lessons in school	40.1	44.8	14.6
I like some science lessons but not all of them	46.1	27.0	26.9
I don't like any science lessons	7.0	23.4	69.6
I like science because it has clear right answers	63.0	26.9	10.1

TABLE 4

Percentages of students' opinions of peers who enjoy science classes

Statement	*I agree a lot, %*	*I agree a little, %*	*I don't agree, %*
People my age who like science are very intelligent	37.4	47.9	14.7
People my age who like science make friends easily	14.7	31.2	54.1
People my age who like science are interesting to talk to	42.1	37.7	20.2
People my age who like science are cool	18.6	35.3	46.1

relation to their attitudes towards science or their attitudes towards their peers who like science. Similarly, there were no significant differences between Muslim and Christian students in relation to attitudes towards science or towards their peers who like science.

With regards to the second research question about conceptions about science, students seemed to identify only things they study about in school as 'science.' Table 5 shows what concepts are considered to be

TABLE 5

Percentages of students' opinions about the activities that are considered science

	Part of science?		
Statement	*Always, %*	*Sometimes, %*	*Never, %*
Science includes making music	3.7	17.3	79.1
Science includes looking at fossils and dinosaurs	52.6	43.8	3.6
Science includes trying to predict whether you will be lucky in the future	7.0	13.9	79.1
Science includes finding out how to cure diseases	57.1	33.9	9.0
Science includes exploring space	60.6	31.5	7.8
Science includes finding out about climate change	47.2	39.7	13.1
Science includes digging up old cities and temples	25.8	42.3	31.9
Science includes healing people who are sick	45.8	37.0	17.1
Science includes farming	36.6	34.2	29.2
Science includes building a bridge	10.1	22.1	67.8
Science includes finding out why some countries are poor and some rich	10.7	25.5	63.8
Science includes finding out why some people learning things more easily than others	25.1	37.4	37.5
Science includes reading about people in the past who discovered or invented things	33.8	40.6	25.6

part of science by students. For example, most students considered looking at fossils, finding out how to cure diseases, finding about climate change, digging up old cities and temples, and exploring space as always being part of science. However, students considered that making music, building bridges, and researching poverty are never part of science. In relation to gender, there were significant differences in students' conceptions about science (favoring boys) related to farming [$\chi^2(2, N=1{,}141)=8.35$, $p=.015$], building a bridge [$\chi^2(2, N=1{,}020)=18.44$, $p=.00$], looking at fossils [$\chi^2(2, N=1{,}162)=7.85$, $p=.02$], exploring space [$\chi^2(2, N=1{,}171)=9.49$, $p=.009$], and researching poverty [$\chi^2(2, N=994)=9.58$, $p=.008$]. There was also a significant difference favoring girls in science regarding healing people [$\chi^2(2, N=1{,}102)=6.65$, $p=.036$]. With respect to religion, there were no significant differences among students in their conceptions about science.

As noted earlier, the conceptions about socioscientific issues were conceptualized as conceptions about environmental socioscientific issues and evolution. For environmental conceptions, results showed that the majority of the participants were at least a little worried about global warming and about scientists discovering or inventing something that will cause a big disaster (Table 6). In addition, half of the participants reported that they will do their best to help save the environment, and about 42 % said that they are careful not to buy products that have been tested on animals. Gender did not seem to have any significance except for the worry about global warming, which was experienced more by boys [$\chi^2(2, N=1{,}255)=9.59$, $p=.008$]. Furthermore, religion (favoring Muslims) seems to play a significant role in relation to the worry that scientists might discover or invent something that will cause a big disaster [$\chi^2(4, N=1{,}125)=12.9$, $p=.012$].

TABLE 6

Percentage of students' conceptions about environmental issues

Statement	*Very true, %*	*A bit true, %*	*Not true, %*
I am worried about global warming	45.5	35.6	18.7
I am careful not to buy products that have been tested on animals	42.5	27.2	30.1
I do everything I can to help to save the environment	51.0	33.7	15.1
I am worried that scientists may discover or invent something that will cause a big disaster	45.8	26.6	27.4

Concerning conceptions about evolution, approximately 40 % of participants thought that God created all life about 10,000 years ago and that their families thought that too. On the other hand, more than one third of participants said that their science teacher thought that life evolved over millions of years, but God created human life. There were significant differences by gender with more girls believing that God created all life about 10,000 years ago and more boys believing in the evolution of life [$\chi^2(2, N=1{,}240)=10.86$, $p=.004$]. Differences were also found between boys and girls regarding what their families thought [$\chi^2(2, N=1{,}216)=12.26$, $p=.002$], but no significant differences were found in relation to what their science teachers thought [$\chi^2(2, N=1{,}183)=3.18$, $p=.204$]. In response to the question that asked students about life on earth including human life, there were no significant differences with respect to religion related to where students thought humans came from [$\chi^2(4, N=1{,}114)=6.31$, $p=.177$] nor to what their teachers thought humans came from [$\chi^2(4, N=1{,}063)=4.65$, $p=.325$]. However, there were significant differences in relation to what students' families thought about the origin of life [$\chi^2(4, N=1{,}093)=14.56$, $p=.006$]. Both Christians and Muslims thought that their families believed that God created all life.

As for the third question, Table 7 presents a summary about the reasons students provided for choosing a particular occupation. A large majority of participants (87.7 %) stated that they would like a job that ensures recognition and respect. A majority also reported that they would like a job that allows them to help others (67.2 %) and make a lot of money (63.2 %). Only about a third of participants (36.7 %) said that they liked a job that is related to science and technology. The significant differences related to gender (favoring girls) in the job choices were

TABLE 7

Percentages of students' reasons for choosing a particular occupation

Statement	*I would like this …*		
I would like a job…	*A lot, %*	*A little, %*	*Not at all, %*
Where I work with others not just by myself	56.4	29.6	14.0
Where I can help people	67.2	26.5	6.2
Where people look up to me and respect me	87.7	9.2	3.0
Where I can discover and invent new things	53.9	32.2	14.0
That will make me well-known	59.4	27.0	13.6
That will get me a lot of money	63.2	29.7	7.1
Related to science and technology	36.7	28.8	34.5

manifested in liking a job that allowed them to help people [$\chi^2(2, N=1{,}249)=7.26$, $p=.027$] while boys favored jobs related to science and technology [$\chi^2(2, N=1{,}250)=6.59$, $p=.037$] that would also allow them to make money [$\chi^2(2, N=1{,}251)=12.09$, $p=.002$]. With respect to participants' religious affiliations, there were significant differences favoring Muslims in the choice of a job that allows them to work with others [$\chi^2(4, N=1{,}123)=10.57$, $p=.032$] and to help people [$\chi^2(4, N=1{,}122)=16.49$, $p=.002$].

Discussion

The results of this study are discussed in terms of the diversity indicators prevalent in Lebanon, and these include gender and religious affiliations.

Attitudes, Conceptions, Careers, and Gender

Unlike students in developed countries (see Baram-Tsabari & Kaadni, 2009), Lebanese male and female upper elementary and middle school students, like students in India, Malaysia, and Turkey who participated in this study (van Eijck, van Griethuijsen & den Brok, 2011), seem to have positive attitudes toward science, and a significant number of them plan to pursue science-related careers, unlike students in the UK and The Netherlands (van Eijck et al., 2011). These results are consistent with the results of a study conducted by Awan, Sarwar, Naz & Noreen (2011) who compared data from different countries and found that students in developing countries have more positive attitudes toward science than students in rich and developed countries. Awan et al. (2011) noted that data from TIMSS 2003 have shown that a relatively high percentage of students in developing countries score high on attitude index in science. These results corroborate some of the findings in a previous study by Osborne & Collins (2001) that showed that the majority of students emphasized the general value of science in society. The reasons or rationales given by the students were, however, more clearly articulated by the girls than the boys. In this respect, some of these girls suggested that they planned to pursue 'caring' science-related careers because of their interest in science and helping others. This finding indicates that girls at the upper elementary and middle school levels in Lebanon had positive attitudes toward science, a finding that appeared in research conducted in Lebanon by Nokari (1998) and also in the USA (Belanger & Peters, 2008). Also, one of the reasons given by students for the

importance of science was that the subject was prestigious. Those who could do science were seen to be intellectually able and enjoyed higher academic status. However, the most common argument for the importance of science was its instrumental value for future careers.

Moreover, the results are also consistent with previous findings from a study by Najafi, Ebrahimitabass, Dehghani & Rezaei (2012) that showed that Iranian middle school students have a positive attitude towards science and technology, with a difference between males and females favoring males. The differences between boys and girls were significant in the favor of boys only in the component related to the attitude towards environmental issues. Results of Najafi et al. also showed that students were interested in a job related to technology, considered science and technology as important to society, and believed that science and technology will find cures to diseases such as HIV/AIDS, cancer, etc. Despite these benefits, the Iranian students believed that science and technology are the cause of the environmental problems and that they mainly benefit the developed countries. At the same time, they emphasized that the benefits of science outweigh its harmful effects.

Moreover, the present study witnessed gender differences in the way students conceptualize science in everyday life and in their preferences for science-related careers and activities. Results show that Lebanese female students prefer human and caring-type activities while males prefer activities that are purely scientific in nature or involve work with mechanical and technical overtones. This result resonates with previous findings (Awan et al., 2011; Haste, 2004) about girls having a strong inclination toward biology (Scantlebury, Baker, Sugi, Yoshida & Uysal, 2007; Uitto, 2014) and jobs that have a human dimension while boys had an inclination to physics- and engineering-related tasks. These gender differences might be the result of different conceptualizations of the role of science by males and females. It seems that females see science in the service of humans while males see it as an attempt to understand and control nature. Furthermore, this could be a manifestation of the Lebanese culture in which stereotypes regarding the roles of men and women in the workforce still exist, an issue that is presently hotly debated in the Lebanese local media.[2]

Furthermore, the positive attitudes among the Lebanese students towards science might have come from parents' perceptions of the importance of science as a vehicle for upward mobility, perceptions that are translated into implicit—and sometimes explicit—pressure by parents on their children to excel in scientific subjects. Due to the near absence of career guidance services and relevant information concerning majors in Lebanese schools and universities, most of the pressure materializes

through the structural role of the family, mainly fathers' influence, particularly over their sons' and daughters' majors (Abouchedid & Kfouri, 2008). In other words, Lebanon's pervasive social and familial context (Barakat, 1984) interferes with people's career choices especially in science-related fields. It is also important to note that Abouchedid & Kfouri (2008) found no evidence of mothers' influence over Lebanese students' career choices and that male students attributed the choice of their majors to family contextual influences more than their female counterparts.

Attitudes, Conceptions, Careers, and Religion

There are several ways that the results of the study regarding the differences associated with religion. First, it is possible that there results are caused by the fact that the majority of students participating in the study were Muslim, and therefore, there is much more variability in this group. Another possible implications comes from the fact that more Muslim than Christian students practice their religion and therefore are influenced by what religious leaders say about the need to help and care for others, the over-reliance on science with consideration to its possible negative effects on society, and the possible harmful products of science.

With regards to conceptions about science, Lebanese students seemed to identify only things they study about in school as 'science,' a finding that is similar to that in students from other developing countries that participated in the study. Moreover, there was a high percentage of Lebanese students who have creationist or theistic conceptions of the origin of the earth, similar to students in India and Malaysia but unlike students in Turkey, the UK, and The Netherlands (van Eijck et al., 2011), a finding that could be attributed to the fact that the theory of evolution is taught in these three countries. These results are aligned with previous findings (Koul, 2006) in which it was found that there was an interplay between scientific and religious ideas in relation to the attitudes of high school students from a Hindu Himalayan region of India. The majority of participants in Koul's study affirmed an authoritarian attitude towards school science. Their results also illustrated that an authoritarian habit of mind was common to both scientific and religious outlooks of students. An authoritarian view of science or 'scientism' is characterized by a belief in the unquestionable authority of scientists, science teachers, and science textbooks. Similarly, religious authoritarianism is characterized by an unquestioning faith in dogma and rituals.

A surprising result of this study relates to the high percentage of students who have creationist conceptions of the origin of the earth. Previous research on evolution education in Lebanon has shown that there are significant differences between Christian and Muslim high school students' views of evolution and the origin of the earth (BouJaoude, Wiles, Asghar & Alters, 2011). There are two possible explanations for these results. First, it is possible that students' age is an important factor in the development of these beliefs. Since these students have not been exposed to evolution and the age of the earth as part of their school curriculum, they might have developed 'everyday' and 'common sense' understandings of these concepts acquired from parents and other significant people in their lives. It is worth noting that research regarding the theory of evolution conducted in Lebanon with upper high school students (BouJaoude & Kamel, 2009b) has shown that significantly more Christian than Muslim students accept the theory of evolution and that more Muslim than Christian students are religious, suggesting that acceptance of evolution is related to religiosity rather than religious affiliation. This finding might also explain the fact that a significant number of the elementary and early middle school students who participated in this study have creationist or theistic beliefs about evolution. It is possible that older students would be more exposed to the media and therefore could have developed conceptions of evolution that are less influenced by their parents. Second, it is possible that, in the current political/social environment in Lebanon and the Arab world where religion and religion-related issues are constantly in the news, students are being influenced by this environment and are developing more conservative religious ideas about science and its relation to religious beliefs even at the tender age of students who participated in this study.

Implications

At least two implications can be drawn from the findings of this study. First, there is a need for concerted efforts to develop and use instructional materials and approaches to help Lebanese students maintain their interest in science and science-related careers. Second, more in-depth research is needed to understand the reasons behind Lebanese students' beliefs about evolution and the age of the earth, an understanding that will help curriculum developers and teachers to address this issue productively. This issue is pressing in Lebanon since, and as noted earlier, the controversial topic of evolution is not included in the Lebanese science curriculum.

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APPENDIX

Examples of items used in the *You and The World around You II*

WHAT YOU LIKE TO DO

2a. Here are some things that you might like to do. Please tick the box next to each one to show if this is something that you like to do **A LOT**, or something that you like to do **A LITTLE**, or something that you **DON'T** like to do very much, or something you would really try to **AVOID**.

		I like doing this A LOT	I like doing this A LITTLE	I DON'T like doing this very much	I would try to AVOID doing this
2a.1	Going to science museums	☐	☐	☐	☐
2a.2	Watching TV programs about animals and nature	☐	☐	☐	☐
2a.3	Finding out how our bodies work	☐	☐	☐	☐

SECTION 3 THINGS YOU DO IN YOUR SCIENCE LESSONS

3b Which ONE of the following statements best describes how you feel about science lessons? Please tick ONE box.

3b.1 I like all science lessons in school ☐
3b.2 I like some science lessons but not all of them ☐
3b.3 I don't like any science lessons ☐

3c For each question please tick the box that best describes how you feel about science lessons

		Very true	A bit true	Not true
3c.1	I like science lessons about living things			
3c.2	I like science lessons about what the world is made of, like atoms and molecules			

3d. Please choose the appropriate response for each item:

		Like it a lot	Like it a bit	Don't like it much	Hate it
3d.1	I like learning science by doing science experiments.	☐	☐	☐	☐
3d.2	I like finding out what happens when I do a science experiment.	☐	☐	☐	☐

SECTION 4: WHAT YOU BELIEVE

4a	**When people talk about 'science' what do they mean?** Please tick the box to show whether you think each of the following are part of 'science' or not.				
		Always part of science	Sometimes part of science	Never part of science	I don't know

4a.1	Making music	☐	☐	☐	☐
4a.2	Looking at fossils and dinosaurs	☐	☐	☐	☐
4a.3	Trying to predict whether you will be lucky in the future	☐	☐	☐	☐

4b **Here are some things that you might believe, or things that you might do. How much is each one true of you? Is it VERY TRUE A BIT TRUE, or NOT TRUE?**
Please put a tick in the box that shows how true each one is for you.

		Very true for me	A bit true for me	Not true for me
4b.1	I am worried about global warming	☐	☐	☐
4b.2	I am careful not to buy products that have been tested on animals	☐	☐	☐

4c Here are some statements about how science 'works'. For each question please tick the box that best describes what you think.

		Strongly Agree	**Agree**	**Disagree**	**Strongly disagree**
4c.1	There is only one correct way to do science and it is the same everywhere.	☐	☐	☐	☐
4d.2	Eventually the data will tell us which one scientific theory is correct and then all scientists will agree about this	☐	☐	☐	☐

4d **Here are some pairs of ideas. Think carefully about each pair of ideas. Which one is closest to what YOU think?**
There are six boxes between each pair. Please put a tick in the box that shows which idea is MOST CLOSE to what you think, and HOW close it is.

Which idea is closer to what YOU believe?

4d.1	Science can help to solve most problems that people face in their life	☐	☐	☐	☐	☐	☐	Science is only useful for a small number of problems that people face in their life
4d.2	What we know today in science is just the best guess that scientists can make from what their experiments tell them	☐	☐	☐	☐	☐	☐	Science tells us what is completely true about the world around us

SECTION 5: SOME MORE ABOUT YOU

5a **Think about a job that you would most like to do when you grow up. What would be important to you when you choose your future job?**
Please tick the box on each line that shows if this is

- something you would like A LOT to have in your future job,
- something you would like A LITTLE to have in your future job,
- or something that you WOULD NOT LIKE in your future job.

		I would like this A LOT	I would like this A LITTLE	I would NOT like this
5a.1	I would like to have a job where I work with other people not just by myself	☐	☐	☐
5a.2	I would like a job where I can help people	☐	☐	☐
5a.3	I would like a job where people will look up to me and respect me	☐	☐	☐

5g Here are some things that different people believe about where we come from.
Do YOU agree most with Dal, Jud or Oll? Please tick ONE box below to show which one **YOU** MOST agree with.

5g.1 DAL says: "Life on earth, including human life, has evolved over millions of years and some creatures, like dinosaurs, became extinct long before humans evolved" ☐
5g.2 JUD says: "Most life on earth evolved over millions of years but God created human life" ☐
5g.3 OLL says: "God created all life on earth at the same time, about 10,000 years ago" ☐

5h **Do you think most of your FAMILY would agree most with Dal, Jud or Oll?**
Please tick ONE box below to show which one you think most of **YOUR FAMILY** would agree with most.

5h.1 DAL says: "Life on earth, including human life, has evolved over millions of years and some creatures, like dinosaurs, became extinct long before humans evolved" ☐
5h.2 JUD says: "Most life on earth evolved over millions of years but God created human life" ☐
5h.3 OLL says: "God created all life on earth at the same time, about 10,000 years ago" ☐

5i **Do you think your SCIENCE TEACHER would agree most with Dal, Jud or Oll?**
Please tick ONE box below to show which of them you think your **SCIENCE TEACHER** would agree with most.

5i.1 DAL says: "Life on earth, including human life, has evolved over millions of years and some creatures, like dinosaurs, became extinct long before humans evolved" ☐
5i.2 JUD says: "Most life on earth evolved over millions of years but God created human life" ☐
5i.3 OLL says: "God created all life on earth at the same time, about 10,000 years ago" ☐

NOTES

[1] http://science-education-for-diversity.eu

[2] See http://www.dailystar.com.lb/News/Lebanon-News/2014/May-12/256087-never-despair-hajj-tells-young-women.ashx#axzz31UBqMxZW

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