LEBANESE STUDENTS' VIEWS OF THE NATURE OF SCIENCE

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Abstract – *This study aimed to elucidate Lebanese middle school students' definitions of science and perceptions of its purpose and usage. Participants were 80 grade 7 and grade 8 students randomly selected from four schools in Beirut, Lebanon. Students filled an open-ended questionnaire and participated in follow-up semi-structured interviews that aimed to generate in-depth profiles of their views of the target aspects of nature of science (NOS). Participants' science teachers and school administrators were also interviewed regarding their views of the same aspects. An iterative process consistent with analytic induction was used to analyze the data and generate themes and categories that were representative of participants' views. Additionally, statistical analyses were conducted to assess whether participants' views were related to background and academic variables. Results indicated that the greater majority of participants held rather restricted views of science: they defined science as an academic subject that 'furnishes information about the world,' perceived its purpose as preparation for higher studies and careers, and mostly saw themselves and others using science in academic—rather than everyday life, settings. Student views were related to their socioeconomic status and type of school (public versus private). Participant science teachers and school administrators held equally restricted views of science. The views held by participants and their teachers are at odds with, and might hinder the attainment of, currently advocated goals for science education, which mainly aim to help students internalize more informed views of NOS as a process and a way of generating valid knowledge about the natural world that is relevant to students' everyday personal and social, as well as academic, lives.*

Introduction

During the past two decades, the international science education community has consistently called for changing the focus of pre-college science teaching (e.g., American Association for the Advancement of Science [AAAS], 1989; Millar and Osborne, 1998; National Research Council [NRC], 1996; National Science Teachers Association [NSTA], 1982, 1993). Traditionally, this focus has been on academic scientific education, which entailed addressing the needs of a

small portion of students interested in pursuing careers as scientists or engineers. Such a narrow focus, which is reminiscent of the reform efforts of the 1960s in the United States, should be replaced with an emphasis on scientific literacy: Science curricula should cater for the needs of *all* students who, as future citizens, are capable of functioning in an increasingly scientific and technological world (Chiappetta, Koballa and Collette, 1998). This calling has been recently echoed in the new Lebanese science curriculum (National Center for Educational Research and Development [NCERD], 1997).

An emphasis on scientific literacy entails a shift from teaching the structure of science (i.e., science content and process skills) to addressing the structure, function, and nature of the scientific endeavor. Pre-college science education should abandon practices that present science as a mere disciplinary school subject that is devoid of personal meaning and divorced from students' everyday lives. Rather, science education should help students realize and experience science as a way of thinking, a means of understanding, and a tool for action that could be fruitfully applied to deal with everyday science-related personal and social issues (AAAS, 1989; NRC, 1996). For instance, science teaching should go beyond helping students solve algorithmic end-of-chapter textbook problems to tackling relevant and contextual everyday problems (NRC, 1996; Anderson, 1987; NSTA, 1993; Yager, 1989, 1991). Indeed, the fact that current science curricula rarely incorporate students' everyday experiences or provide them opportunities to apply their science understandings in relevant situations stand in sharp contrast with research findings, which indicate that emphasizing everyday applications improves students' knowledge, skills, and attitudes (NRC, 2003; Ramsden, 1994), and offers them important opportunities for cognitive growth (Saxe, 1990).

A learner's science worldview provides a framework that is used to interpret and make sense of science learning experiences (Cobern, 1996; Edmondson, 1989; Songer and Linn, 1991). Such worldview is, at least, partially related to students' conceptions of nature of science (NOS) in general, and their perceptions of the purpose of science and its usage in particular. Designing curricula and implementing instructional practices that are successful in helping students internalize the aforementioned view of science as a meaningful and functional endeavor (e.g., AAAS, 1989; NCERD, 1997) requires an understanding of how they define science and perceive its purpose, and how they think science relates to everyday life. A number of research studies investigated students' definitions of science in the United States and Canada (e.g., Charron, 1991; Griffiths and Barry, 1993; Ledbetter, 1993; Reif and Larkin, 1991; Ryan and Aikenhead, 1992; Song and Black, 1991; Songer and Linn, 1991; Urevbu, 1991). However, there is limited research on students' perceptions of the purpose(s) of science and its use in everyday life. Moreover, both lines of research are non-existent in the Lebanese context.

The new Lebanese science curriculum is still in its initial implementation and revision phases. These revisions could benefit greatly from an empirical account of Lebanese students' views of science and its use in everyday life. Such an account could also inform science teachers and help them modify their teaching practices with the aim of providing students with more meaningful and relevant science learning experiences. However, it has long been realized that teachers are the primary intermediaries of the science curriculum (Brown and Clarke, 1960) and that the successful implementation of curricular or instructional changes requires the support of school administrators (NRC, 1996). As such, it is crucial that any exploration of students' perceptions of the target aspects of NOS be coupled with exploring the views of science teachers and administrators of the same aspects.

Thus, the purpose of the present study was to elucidate Lebanese middle school students' definitions of science and perceptions of its purpose and use in everyday situations, and the relationship between these students' views and selected background and academic variables. A secondary purpose of the study was to elucidate the views of science teachers and administrators of the same aspects of science. The specific questions that guided the present investigation were:

(1)   What are participants' definitions of science and perceptions of its purpose(s)?
(2)   Where and how do participants see themselves and others using science, particularly in relation to everyday life situations?
(3)   Are participant students' perceptions related to background variables, including school type (private *versus* public), grade level, sex, achievement, and parent's (or primary provider's) occupation?

Background

The past two decades have seen a shift in the goals of science education in response to social pressures to prepare citizens who are decision makers. The emphasis of science curricula has shifted from the structure to the structure and the function of science (AAAS, 1989; Anderson, 1987); from science that prepares scientists and engineers to science that helps people deal with practical or day-to-day problems (Ebenezer and Zoller, 1993; NRC, 1996). This change in emphasis is meant to make science more relevant to students' lives.

During the mid-1970s science curricula emphasized the conceptual structure of scientific disciplines and associated processes of inquiry. This was followed in

the late seventies and early eighties by the 'back to basics' movement, which resulted in teaching very specific knowledge objectives to the neglect of more general process-oriented ones. However, starting with the early eighties, there was a shift toward science-technology society (STS) objectives and in some cases to science-technology-environment-society (STES) objectives (Chiappetta et al., 1998; Sammel and Zandvliet, 2002; Zoller et al., 1990). Science in the STS and STES frameworks is presented in the context of science-technology related issues and scientific inquiry is presented as inquiry into personal, environmental, and societal problems for the purpose of making informed decisions (Trowbridge, Bybee and Powell, 1999). Both teachers and leaders in science education supported the STS movement and its functional goals (Mcintosh and Zeidler, 1988; Waks and Barchi, 1992; Ramsey, 1993).

Nonetheless, while the STS and STES goals have been accepted theoretically in the science education community, in practice, science teachers continued to emphasize the preparation of students for higher grades (Beisenherz and Yager, 1991; Trowbridge *et al.*, 1999), neglect the social dimensions of science, and describe science in terms of exploring the unknown and discovering new things (Rubba and Harkness, 1993). Teachers did not attempt to link science to students' everyday life. These teaching practices transformed science into a 'set of inert ideas that are not generative, not interactive with the explanations children have constructed themselves for natural phenomena' (Hawkins and Pea, 1987, pp. 298-299). More recently, the goals of the STS movement and the associated functional perceptions of science were subsumed under the more global umbrella of scientific literacy (e.g., AAAS, 1989, 2001; NRC, 1996).

Students and science teachers' definitions of science were found to be remarkably similar (Ledbetter, 1993). Research on students' views in the United States has shown that they ascribe to a restricted view of science. Students perceive science as a school subject with no relevance to real life (Charron, 1991; Reif and Larkin, 1991; Song and Black, 1991; Urevbu, 1991). Ryan and Aikenhead (1992) and Griffiths and Barry (1993) asserted that the majority of their participants perceived science as a body of knowledge or the study of science fields such biology and physics. Ledbetter (1993) has shown that science as discovery, school centered activities, and natural phenomena and their actions were the top three definitions of science presented by grade 7-12 students.

Charron (1991) found that elementary students associated science with active doing while high school students associated it with passive learning. Moreover, she found that most students and their parents thought that science had almost no bearing on their everyday lives. Songer and Linn (1991) reported that middle school students held three types of views about science: static, dynamic, and mixed. Students who ascribed to the static views affirmed that science is a

collection of facts that are best learned through memorization. Students who characterized science as dynamic ascertained that science is tentative and that understanding science is the best approach to learning it. Finally, students with a mixed view of science held elements of both static and dynamic characterizations simultaneously. In this regard, it should be noted that holding a restricted definition of science is not limited to students. Yager and Penick (1988) found that members of community organizations realized the necessity of teaching science for daily living but their priority was for academic preparation. Furthermore, research has shown that elementary science textbooks focus on academic preparation while neglecting the relevance of science to students' lives (Staver and Bay, 1987).

Several approaches have been advocated to help students internalize the relevance of science to everyday life. In addition to the aforementioned STS movement, O'Brien (1993) advocated using toys in science teaching to extend learning beyond the classroom and provide students with opportunities to see science in action. Roth (1992) and Sanders (1994) envisioned a role for technology in bridging the gap between classroom and real life situations. Sanders (1994) suggested using science activities to give middle school students a chance to see real-world applications for science, mathematics, and technology. Roth (1992) argued for providing students with opportunities to use computers in solving ill-defined problems that are similar to real life problems, which are rarely experienced in the science classroom. Finally, according to Martin and Brouwer (1991), one way to make science relevant to students' lives is by using stories, narratives, and anecdotes that 'open up the possibility of involving the imagination of students and . . . demand participation from students [because] . . . students themselves are involved in giving meaning to the stories, and such stories resonate with the lives of individual students in personal ways' (p. 719).

Method

Participants

Two private and two public schools in Beirut, Lebanon participated in the study. The schools were randomly selected from a list of private and public schools available in the Lebanese Ministry of Education. One grade 7 and one grade 8 classroom were randomly selected from each school and ten students from each of the resulting eight classrooms were chosen to participate in the study. Participant students were 80 middle school students (50% female) with an age range of 11–13 years. The selected students represented a range in terms of

socioeconomic status and achievement levels. Additionally, the selected six classroom science teachers (in the case of two participant schools, grade 7 and grade 8 were taught by the same teacher) and the four school principals were asked to participate in the study.

Procedure and instruments

An open-ended questionnaire in conjunction with follow-up individual interviews was used to explore participants' views of the target NOS aspects. This approach was used with the intent of avoiding the problems inherent to the use of standardized forced-choice or convergent instruments, such as the *Nature of Science Test* (Billeh and Hasan, 1975) and *Nature of Science Scale* (Kimball, 1967-68), which have been traditionally employed to assess learners' NOS views. These problems stem from the assumptions underlying the development of these instruments and their format, and cast serious doubt on whether such instruments generate valid assessments of respondents' NOS views (Abd-El-Khalick, Lederman, Bell and Schwartz, 2001). By comparison, open-ended questions allow respondents to express their own views on the target issues related to science and alleviate concerns related to imposing a particular view of the scientific enterprise on respondents. Moreover, coupled with data from individual interviews, responses to open-ended questions allow the assessment of not only respondents' positions on the target issues, but the respondents' reasons for adopting those positions as well (Aikenhead, 1988; Aikenhead, Ryan and Desautels, 1989).

An initial set of open-ended questions was piloted through individual interviews with 10 students from schools similar to those participating in the study. These questions were modified according to students' responses, comments, and feedback, and used to construct the open-ended questionnaire. The resulting questionnaire was piloted with another 10 students and further modified. Since the medium of science instruction in Lebanon is either French or English, the questionnaire was written in both languages. Care was taken to insure the consistency between the two versions of the questionnaire. This was established by translating the questions from English to French by one expert and back to English by a second expert. Then, the initial set of questions in English was compared to the final translated set to insure that translation did not change the content of the questions. This iterative process resulted in a final set of four questions that were comprehensible to participant students and that helped to elucidate their views of the target aspects of science. The questions were:

(1)   What is your definition of science? What comes to your mind when you hear the word science?

(2) What is the purpose of science? Why do you study science?
(3) Did you use science in the past few days? Where? How did you use science?
(4) Did you see others using science in the past few days? Where? How did they use science?

All participant students filled out the questionnaire and sat for individual interviews approximately two weeks later. During the interviews, participants were asked the same set of questions as on the questionnaire. These questions were often followed by clarification and probing questions. The two investigators conducted the interviews in a relaxed environment and in the language in which the participants felt most comfortable. Consequently, most students used Arabic with some English or French words. The interviews lasted between 15 and 35 minutes each and were audio-taped and transcribed verbatim for subsequent analysis. These interviews allowed checking the consistency of participants' responses and probing their views in depth. Participant science teachers and school administrators were also interviewed using the same set of questions.

Information about school type (public *versus* private), and participant students' sex, grade level (grade 7 or grade 8), achievement (high, middle, or low), and father's occupation (professional, semiskilled, unskilled, or unemployed) was collected during the interviews and from school records. In this regard, it should be noted that the background variable 'mother's occupation' was not used in the present analysis because very few students reported having working mothers.

Data analysis

There were two phases of data analysis. The first phase was conducted using the process of analytic induction (Bogdan and Biklen, 1982; Goetz and LeCompte, 1984). This process involved scanning the questionnaire and interview responses for categories and relationships among categories, and 'developing working typologies and hypotheses upon examination of initial cases, then modifying and refining them on the basis of subsequent cases' (Goetz and LeCompte, 1984, p. 180). The investigators conducted the initial stages of data analysis of this phase independently. Following each stage they met to discuss the results and resolve any differences in the categorization. They collaborated, however, on the last stage of analysis and the final set of categories and frequency counts were a result of this process. Data analyses showed that some participants' responses contained more than one type of category. Consequently, the reported percentages do not always add up to 100% and a higher percentage suggests that a certain category appeared more often in the responses.

The second phase of data analysis explored the relationship between participant students' perceptions, and background and academic variables. This exploration was achieved by combining categories into more inclusive ones, which resulted in reducing the number of categories and allowed coding each participant under one category. This process, however, presented the problem of coding the responses of 15 students that appeared to belong to more than one category. The problem was resolved by coding the responses based on the first category appearing in the response. The assumption was that the first response was more spontaneous and thus more representative of a participant's views. Then, the data were analyzed by investigating the possible relationships between the generated categories and each of the aforementioned variables (i.e., school type, grade level, sex, achievement, and parent's occupation) using non-parametric Crosstabs and Chisquare of the statistical package SPSS for Windows, Version 10.0.

Results

Participant students' views of the target NOS aspects were similar to a large extent to those of their teachers and school principals despite differences in the complexity of the language used to convey these views. The following sections will primarily focus on reporting the results for the student participants, where comparable categories resulted from analyzing the questionnaire and interview responses. While higher frequencies for each category emerged from the interviews, the percentages were similar for both interviews and questionnaires. The results presented in this paper are those derived from analyzing the interview transcripts since they offered a richer and more detailed data source than the questionnaires.

Students' definitions of science

Six definitions of science emerged from students' responses. The majority of students (63.8%) noted that science was a subject that 'gave information' about humans, animals, plants, the earth, the sky, and/or the stars. The second most common definition, which accounted for 35% of student responses, suggested that science was a subject matter divided into other subjects such as physics, chemistry, and biology. Science as 'a method for doing things' and as 'a subject to teach us new things' tied for third rank: These two definitions appeared in the responses of 18% of the students. Next, 16.3% of the students proposed that science was 'a subject that enlightens and leads to truths about nature.' Finally, science as a subject studied in class appeared in the responses of 10% of the students.

Students' perceptions of the purposes of science

Students discerned six main purposes for science. These were: Academic preparation, preparation for future careers, achieving higher social status, helping people solve everyday problems, discovering new things, and helping people appreciate and understand nature. Table 1 presents these categories, and their definitions (in students' terms) and associated percentages. The most commonly stated purpose of science was academic preparation, followed by preparation for future careers. The third most commonly stated response was achieving higher social status. It seems that students have been socialized to think that science-related professions – referring specifically to occupations in the engineering and medical fields, were associated with high social status in Lebanon. Consequently, for these students, the purpose of science was to prepare them for these professions. Indeed, these three categories were interrelated in the thinking of many students: 55% of those students who noted that the purpose of science was to prepare them for future careers also included academic preparation and social status in their discourse regarding the purpose of science. In addition to the above categories, 17.5% of student responses indicated that they realized the importance of science in everyday life. Finally, a minority of students said that the purpose of science was to discover new things (8.3%) and to help people appreciate and understand nature (5%).

Students' perceptions of their use of science

To be sure, some students noted that they never used science. However, the majority of students believed that they used science in four domains. These were using science in academic settings; to solve everyday problems; in hobbies, during play or when engaging sports activities; and when performing activities related to their bodies or during sickness. Utilizing science in school settings, such as doing science homework, preparing for examinations, answering science questions in class, and working in the laboratory, was the use reported by 66% of students. Only 13% of the participant students noted that they used science to solve everyday problems, such as changing light bulbs, checking for gas leaks, fixing radios, taking care of plants, and dealing with farming-related activities. Eight percent of the students said that they used science in hobbies, during play, or during sports activities. Under this category, students mentioned playing with magnets, building small engines, playing basketball or soccer, and building model boats and airplanes. Another 8% of students said that they used science when they performed activities related to their bodies or during sickness. Examples provided under this category included eating, drinking, falling ill, or breaking a leg. Finally,

TABLE 1: Purposes of Science as Perceived by Participant Students

Category	The purpose of science is to:	Percent
Academic Preparation	Teach us about animals, plants, the world, and life	52.2
	Prepare us for higher studies and higher classes	11.3
Future Careers	Prepare us for future careers	46.5
	Help us achieve our goals and succeed in life	11.3
Social Status	Answer questions and take part in conversations in, and out of, school settings	21.5
	Give higher social status	8.8
Solving Everyday Problems	Help people in their daily lives such as in deciding what to eat, how to take care of oneself, and how to fix things	17.5
Inventing and Discovering	Discover new things that improve their standard of living	8.3
Understanding Nature	Help people become closer to nature and to understand their surroundings	5.0

19% of the students said that they did not use science regularly. When these students were asked to elaborate, they were unable to think of any use of science except an occasional mention of 'studying science.'

Students' perceptions of the use of science by others

There were eight categories of perceived science usage by others, the most prevalent of which were associated with academic and career related activities. Thirty-six percent of the students noted that they saw others using science in school settings, such as teachers teaching science, classmates studying science, or teachers and students performing laboratory experiments. Another 18% said

that they had seen others using science in academic related activities outside the school including seeing friends studying science, siblings performing required experiments at home, and relatives preparing to teach science lessons. About 31% of participant students believed that professionals, such as doctors, engineers, electricians, nurses, pharmacists, and mechanics, used science. Other categories elucidated by participant students included seeing science being used by individuals in the media, such as in television programs or the movies (8%), parents when reading science related books or magazines (8%), and athletes during sports competitions (4%). A mere 4% of all students said that they saw others using science in solving everyday problems. Examples of activities given under this category included fixing radios and other electrical appliances and farming. Finally, 5% of the students said that everybody used science and 18% said that they did not remember seeing or encountering others using science.

Relationship between students' perceptions, and background and academic variables

Frequencies resulting from the second phase of data analysis were examined using the background variables of school type, grade level, sex, achievement level, and father's occupation. The results of this analysis are presented in the following sections.

Definition of science: Three categories of the definition of science were used in this analysis: Science as a school subject, science as doing, and science as the 'truth.' Students' definition of science differed by school type ($c_2 = 20.9$, $p < .05$). Definitions provided by students in the two public schools were different from those of the private schools and from each other. Eighty-five percent of the students of one public school (Public-1) defined science as a school subject as compared to 65% in both private schools and 40% in the second public school (Public-2). Also, 5% of the students in Public-1 defined science as the truth as compared to 50% in Public-2 and 10% in the two private schools.

Purpose of science: Three categories were used in the analysis: Academic preparation for careers, solving everyday problems, and inventing and discovering. There were no statistically significant differences on any of the possible relationships in this analysis. However, several differences, while not significant, were intriguing. In particular, the lowest percentage of students who noted that the purpose of science was to solve everyday problems came from the public school (Public-1) in which the largest percentage of students defined science as a school subject. Moreover, more students in the private schools than

in the public ones said that the purpose of science was to solve everyday problems. Finally, more females than males believed that the purpose of science was to invent and discover new things.

Students' use of science: All aforementioned five categories were used in the analysis. These were using science: in academic settings; to solve everyday problems; in hobbies, during play, or during sports activities; and when performing activities related to the body or during sickness; and not using science. There were statistically significant differences by school type ($c_2 = 25.8$, p < .05) and father's occupation ($c_2 = 24.9$, p < .05). More students in the public than in the private schools said that they did not use science. Also, more students whose fathers were professionals said they used science in hobbies and body-related activities and more students whose fathers were unskilled or semiskilled said that they used science in academic settings. Even though not statistically significant, it is worth noting that more females than males said that they did not use science while more males than females said that they used science in hobbies.

Students' perceptions of science usage by others: Five of the eight categories of students' perceptions of science usage by others were included in the analysis. These were 'nobody uses science,' 'everybody uses science,' and use of science by others in academic settings, in careers, and in daily life. Students' perceptions of this aspect differed by fathers' occupation ($c_2 = 21.5$, p < .05). More students' whose parents were professional or semiskilled than unskilled said they saw science used by others in careers and more students whose parents were unskilled than professional or semiskilled said they did not see science being used by others. A few other interesting patterns, though statistically insignificant, emerged from this analysis. In particular, it was found that a higher percentage of students in public schools than in private schools said they saw science being used by others in academic settings.

Administrators' and science teachers' perceptions

As noted earlier, participant administrators and science teachers held views that were similar to those of their students. Most of the aforementioned categories related to defining science and enumerating its uses were evident in the discourse of teachers and administrators. These latter participants held equally restricted and naïve views of science as a mere academic discipline and/or a method aimed at collating and documenting 'facts' about the natural world, discovering 'truths' about the workings of natural phenomena, and/or producing useful inventions that target the enhancement of the human condition. Moreover, even though a substantially larger percentage of science teachers and administrators than

students believed that everyone uses science, the domains of usage enumerated by the former participants were similar to those discerned by students. One noticeable difference in this regard was that, unlike the public school science teachers, the private schools teachers believed that students used science in hobbies and 'for fun' outside classroom settings. As it turned out, these teachers were referring to annual science fair competitions that were organized in both private schools. These fairs, nonetheless, were perceived as occasions to reinforce students' academic science learning. Finally, it is worth noting that almost all teachers and administrators emphasized the significance of science as an academic subject that would allow students to access high status science-related professions (e.g., physicians and engineers), which would greatly benefit those students and their communities. Indeed, both teachers and administrators alike took great pride in pointing out their successes in helping their students 'succeed in science' in the participant schools.

Discussion and conclusions

Participant Lebanese middle school students, like their counterparts in the United States and Canada (e.g., Charron, 1991; Griffiths and Barry, 1993; Reif and Larkin, 1991; Ryan and Aikenhead, 1992; Song and Black, 1991; Urevbu, 1991), ascribed to a restricted view of science. The majority defined science as an academic subject, and perceived its purpose as preparation for higher grades, higher studies, and careers, and saw themselves and others using science mostly in academic settings. Only a small minority of students saw science as something relevant to their everyday lives outside the classroom when they noted that they used science in hobbies or that science relates to their bodily functions (e.g., during sickness). Students' perceptions were significantly related ($p > .05$) to the type of school in which they were enrolled and to their father's occupation. More public than private schools students defined science as an academic subject, said that they did not use science, or that they used science in academic settings. Additionally, more students whose fathers had professional careers than those who did not noted that they used science in hobbies and that they saw others using science in career settings.

The relationship between participant students' perceptions, and the type of school and father's occupation may be explicable to a substantial extent by a more global factor, namely, students' socioeconomic status (SES). Most Lebanese public schools serve students of low SES and most parents with professional degrees, and consequently higher SES, send their children to private schools. SES influences parental and career expectations to a large extent (Alexander and

Entwisle, 1988; O'Neill, 1978). In a country like Lebanon, where science is intimately associated in the public's mind with privileged and high-status careers (particularly careers in the engineering and medical fields), obtaining a professional science-related degree is perceived as a means to climb the social ladder. Thus, unskilled and semi-skilled parents tend to place *exclusive* and high emphasis on their children's science achievement and academic success, which is associated with high status careers and high income. This emphasis is translated into expectations, which are often explicitly verbalized and communicated to students. Nonetheless, these expectations are rarely coupled with commensurate support at home given the parents' restricted educational capital. This argument does not entail that Lebanese parents with professional careers and/or higher SES tend to place less emphasis on academic achievement or attaining high-status professions. However, given their educational, social, and/or economic capital, these latter parents value the holistic development of their children and often couple their high expectations with active engagement in their children's education. These parents, for instance, discuss school topics, including science, with their children and partner with them to design and execute science fair projects.

Students' definitions of science and perceptions of its purpose and usage, like other student perceptions, are not only influenced by out-of-school factors, such as parental expectations, social status associated with science, and career expectations. School-related factors, including curriculum, school administration, teachers and teaching, and external examinations, play an equally important role in shaping students' perceptions. Of these latter factors, we believe, only the curriculum has been substantially changed during the past five years. The old Lebanese science curriculum emphasized science as a mere academic subject. The curriculum was restricted to a list of science topics with an occasional statement regarding the use of science process skills. As noted earlier, the new Lebanese science curriculum that was put forth in 1997 (NCERD, 1997) represented a drastic departure from the old curriculum in terms of alignment with recent international trends in science education (e.g., AAAS, 1989; NRC, 1996). In addition to emphasizing the disciplinary structure of science, this curriculum now places emphasis on the function and NOS. However, it is not clear to what extent will this change in the curriculum bring about a change in students' perceptions of science. This is especially the case given that this curricular change has been accompanied by relatively minimal change in other school-related factors.

Among these school factors are high stakes examinations. These examinations, which emphasize knowledge and comprehension level instructional outcomes and algorithmic problem-solving (Kraidy and Fares,

1984), still determine much of what goes on in pre-college education in Lebanon. By the end of middle school, Lebanese students sit for national examinations that determine whether students are promoted to high school. These examinations also impact whether students can pursue the scientific stream in high school. Again, by the end of secondary education, students sit for even higher stakes national examinations, which represent their gateway for admission to colleges and universities. Success in these national official examinations is a prerequisite for achieving professional degrees and, thus, is given high priority by parents, teachers, and administrators. Consequently, school administrators and teachers strive to complete the specific requirements of the curriculum and adopt highly targeted instructional practices to prepare students to succeed in official examinations. Indeed, we have seen that teachers and administrators in the present study hold very restricted views of science as an academic discipline and stress its use for the academic preparation of their students.

The interaction between school and out-of-school factors has created a culture of 'science as an academic subject' that permeates all levels of education in Lebanon. This type of science education prepares students to pass examinations, enroll in college, and secure professional science-related careers. Thus, while there are no official examinations in grades 7 and 8, the major concern of parents, teachers, and school administrators is how to provide students at this level with the prerequisite knowledge and skills necessary to achieve high grades in science and pass examinations in preparation for the future. The major concern of students, on the other hand, is how to adapt to and negotiate these requirements. As such, the results of this study are not unexpected.

While anticipated, the instructional overemphasis on the structure of science, rather than on the structure, function, and NOS, may be problematic. In a developing country in which confronting environmental and other science-related issues is a major concern of citizens and decision makers, there is a need to prepare scientifically literate individuals besides preparing medical doctors and engineers (NCERD, 1997). An educational system that emphasizes science as an academic subject may produce citizens who 'know' much science but are unable to address science-related everyday and societal problems (Abou Assli, 1995). Consequently, there is a need to contemplate the possibility of incorporating everyday examples (e.g. hobbies) and ways of solving everyday science-related problems in the science curriculum and in teacher preparation programs to give students a broader view of science and render it relevant to their lives.

In this regards, two questions, which are relevant to the issue of changing the curriculum and changing students' views about science, need to be answered. First, is it possible to transform the prevailing culture by only changing the curriculum? Second, should the culture be changed if it meets students', parents',

and teachers' needs? A prevailing culture is hard to change especially when sociocultural expectations and students' specific agendas and views are compatible (Wildy and Wallace, 1995). Moreover, why should a prevailing culture be changed if it meets the needs of all stakeholders? Answers to these and similar questions are needed while considering the agendas of all those concerned with science education in Lebanon and other countries with similar conditions and aspirations.

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