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**Association News**

**Constantine Hadjilambrinos**

Two years after the organization transformed itself from the National to the International Association for Science, Technology and Society, it reached outside the United States for the first time for its new president-elect. Dr. Willem H. Vanderburg is Director of the Centre for Technology and Social Development, at the Faculty of Applied Science and Engineering of the University of Toronto. He is also Editor-in-Chief of the Bulletin of Science, Technology and Society. About his concerns with the interaction between science and technology on the one hand and today’s society on the other, professor Vanderburg writes: “When I listen to the many debates around international meetings, conferences and treaties related to issues such as globalization, free trade, global warming and sustainable development, I am left with a sense that we are not about to gain ground on the most difficult issues that face humanity and our planet. Somehow we are always made to believe that we must make tough choices between having enough energy to run our societies and global warming, between livable and sustainable cities and affordable municipal taxes, between healthy workplaces and remaining competitive in the global race, between competitive corporations and adequate health insurance and social security, between education and training for the information age, and so on. It would appear that both sides of these debates have bought into our reigning secular economic theology, which holds that our human values and aspirations can be considered only insofar as economic growth can pay for them. These now appear to be the "laws and the prophets" for the twenty-first century.”



Dr. Willem Vanderburg

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## Pre-service Teachers' Knowledge and Perceptions of Social Issues

John E. Pedersen and Hakan Turkmen

### Introduction

We are in the information age; however information alone will not improve our democracy, society, education system, or us as citizenry. Today, nations are more closely linked by technology than they have been at any time in our global history. Thus, technology and science are playing a major role in shaping our modern world. But technological and scientific changes are infrequently reflected in the way most schools in the United States prepare students. The purpose of an education is not only to educate students for a career, but also to challenge them to think about the meaning and purpose of life. If today's students are to become tomorrow's decision makers, they need to be taught about science, technology, and society from a global perspective. Without knowledge of these connections and the perspectives of other peoples, students cannot make informed decisions.

Although some educators may consider that the discussion of controversial social issues is not the business of science lessons, most of them may judge the application of science-technology-society (STS) of valuable in helping students to contextualize their experience of school science. However, science teachers, educators, and scientists have been arguing for the integration of STS issues in science curriculum, over the past few decades (Aikenhead, 1992; Aikenhead, Fleming, & Ryan, 1987; Aikenhead, & Ryan, 1992; Bybee, 1987 and 1991; Bybee, & Mau, 1986; Cheek, 1992; Heat, 1992; Kranzberg, 1991; Kumar, & Berlin, 1998; Kumar, & Chubin, 2000; Lumpe, Haney, & Czerniak, 1998; May, 1992; Merryfield, 1991; Mitchener, & Anderson, 1989; Ost, & Yager, 1993; Reis, & Galvao, 2004; Rubba, 1989 and 1991; Rubba, & Harkness, 1993; Ryan, 1987; Sadler, 2004; Scharmann, Shroyer, & Lee, 1997; Schoneweg Broadford, , Rubba, & Harkness, 1995; Solbes, & Vilches, 1997; Tsai, 2001; Yager, 1996; Yager, & Lutz, 1995; Yager, & Tamir, 1993; Wiesenmayer, & Rubba, 1999). In the mid 1990's, the "National Science Education Standards" (National Research Council, 1996) presented content standards related to students' understanding of the global interconnectedness between science, technology, and social perspectives. Additionally, the National Council for the Accreditation of Teacher Education (NCATE) has indicated that science education programs preparing science teachers should be able to establish that their teacher candidates (pre-service teachers) should know, understand, and be able to demonstrate their ability to teach science in a way that prepares children to make decisions and take action on contemporary science- and technology-related issues of interest to the general society (2003). These reforms clearly indicate an educational agenda designed to address student's need to engage in discourse related to STS issues. Toward this objective, science instruction should value the students' respective cultures, experiences, and circumstances in an effort to prepare them for citizenship in our global community (Wiesenmayer & Rubba, 1999).

Many of the "issues" associated with STS can be controversial in nature, contributing to the debate with regard to implementing it in the science classroom. Issues such as sexism, race, ethnic discrimination, class stratification, homophobia, reproductive rights, world hunger, population growth, air quality, water resources, war technology, human health, acid rain, problems in the ozone layer, cloning, stem cells, genome project, and global warming place science teachers in a situation not traditionally associated with the conventional realm of "safe" science. There is no doubt that these issues are relevant to students' lives, impacting them personally, but recent scholarship indicates that little is being done to address these global concerns either in the K-12 classroom or in the preparation of teachers challenged to integrate STS. The current study begins to address these shortcomings by examining the perceptions of pre-service teachers regarding social issues and the teaching of social issues in K-12 settings. Little is known about pre-service teacher's perceptions regarding social issues and how they perceive their obligation to infuse their teaching with a discussion of social issues.

## Purpose of the Study

The research appears to be clear: STS does have a positive impact on student achievement, attitudes, and awareness. With the support of current reform efforts and validation via research, one might assume that STS is being taught in K-12 settings. Yet, Pedersen and Totten (2001) found that although teachers believed that they were capable of teaching controversial STS issues, they felt poorly prepared by their teacher preparation programs and relied almost exclusively on textbooks as the primary source for their science curriculum. Additionally, Totten and Pedersen (1996) established that students across the United States believed that they had little impact on social issues and did not feel that science courses addressed social issues in any specific manner. It is desirable, then, to understand pre-service teacher's awareness of their own beliefs about social issues, as well as to more clearly appreciate how pre-service teachers perceive the value their future students will place on studying social issues.

The primary purpose of this study is to identify pre-service elementary teacher's views about teaching social issues and highlight their perceptions with respect to their vision of most effective method of teaching K-12 students about social issues. The questionnaire used for this study was first developed and used by Totten and Pedersen (Totten and Pedersen, 1994). For the current study, the questionnaire was placed on-line to provide an opportunity for the participants to answer the questions outside of the method's classroom and consisted of items identifying demographic data and general questions related to the study of social issues. The reliability of the instrument is documented at .89.

Participants in the study were students enrolled in a pre-service elementary science methods course at a major southwestern university. The participants were instructed to go to the questionnaire URL, log in, and complete the questionnaire. Instructions directed that they should fill out the survey in one sitting and answer all questions. Thirty-three students (out of 40 enrolled) completed the anonymous survey for an 82.5% return rate (see Table 1 for Demographic Data).

## Results

For the purpose of this study, the results of the survey were collapsed into broad categories and grouped thematically with respect to the questions. The broad categories are: how pre-service teachers obtain information on social issues (Tables 2, 3, & 4); how K-12 students learn about social issues (Table 5); awareness of and/or involvement in community service projects (Table 6); pre-service teacher's perceptions regarding the impact that they could have in regard to addressing social issues (Tables 7, 8 & 9); and pre-service teacher's perceptions of their own and their K-12 students impact on social issues (Table 10 & 11).

**Table 1**  
Demographic Data

<b>Gender</b>	
Male	6.1% (2)
Female	93.9% (31)
<b>Ethnicity/Race</b>	
Asian	0% (0)
African American	3% (1)
Caucasian	78/8% (26)
Hispanic	3% (1)
Native American	12.1% (4)
Pacific Islander	0% (0)
Other	3% (1)

**Table 2**  
Where Pre-service Teachers Receive Information about  
Social Issues: Schools/Clubs

School/Clubs	Not Important	Somewhat Important	Important	Very Important
Social Studies	3% (1)	16% (5)	25% (8)	<b>56% (18)</b>
Science	6% (2)	28% (9)	<b>41% (13)</b>	25% (8)
English	6% (2)	19% (6)	<b>44% (14)</b>	31% (10)
Religious Class	0% (0)	19% (6)	<b>41% (13)</b>	41% (13)
School Clubs	9% (3)	16% (5)	<b>56% (18)</b>	19% (6)
Health Class	6% (2)	<b>41% (13)</b>	38% (12)	16% (5)
Out of School	12% (4)	28% (9)	<b>38% (12)</b>	19% (6)

### **Pre-service Students Obtaining Information on Social Issues**

Pre-service teachers were asked, based on items listed on the instrument, where they obtain most of their information on social issues. Items on the instrument ranged from courses in school settings, dialogue with individuals, and information disseminated by the media. Upon examination of the data, definite patterns emerge in the answers provide by these pre-service teachers. Between 75% and 82% of the students indicated that Social Studies, English and Religion courses were either important or very important with regard to their exploration of social issues. By comparison, Science and Health courses, as well as out of school experiences ranged in importance between 34% and 47% of respondents, demonstrating that those courses were either not important or only somewhat important. In the subject area of science, of prime interest to these researchers, 34% of the pre-service teachers indicated that it was only somewhat or not important while 66% indicated that science was important or very important for gaining information related to social issues (see table 2). Additionally, pre-service teachers indicated that friends, teachers, and parents were all are sources that provide important or very important information on social issues (see Table 3).

**Table 3**

Where Pre-service Teachers Receive Information about Social Issues: Individuals

<b>Media</b>	<b>Not Important</b>	<b>Somewhat Important</b>	<b>Important</b>	<b>Very Important</b>
Friends	3% (1)	6% (2)	38% (12)	<b>53% (17)</b>
Parents	3% (1)	0% (0)	22% (7)	<b>75% (24)</b>
Teachers	0% (0)	9% (3)	31% (10)	<b>59% (19)</b>

Pre-service teachers responding to this instrument were also asked to indicate which media sources they used to gather information about social issues. Sixty to 79% of respondents indicated that national television; local television; and local and regional newspapers were important or very important as sources of information on social issues. Ranking far below these media sources were school events television (28% important/very important), MTV (29% important/very important), and teen magazines (19% important/very important) (see Table 4).

**Table 4**

Where Pre-service Teachers Receive Information about Social Issues: Media

<b>Media</b>	<b>Not Important</b>	<b>Somewhat Important</b>	<b>Important</b>	<b>Very Important</b>
Local TV News	3% (1)	28% (9)	<b>41% (13)</b>	28% (9)
Local Radio	9% (3)	<b>34% (11)</b>	22% (7)	<b>34% (11)</b>
Local Newspaper	9% (3)	25% (8)	25% (8)	<b>41% (13)</b>
National TV News	3% (1)	19% (6)	38% (12)	<b>41% (13)</b>
Movies	16% (5)	<b>35% (11)</b>	29% (9)	19% (6)
National Magazines	12% (4)	<b>44% (14)</b>	19% (6)	25% (8)
MTV	<b>35% (11)</b>	<b>35% (11)</b>	10% (3)	19% (6)
Teen Magazines	<b>45% (14)</b>	35% (11)	13% (4)	6% (2)
National Public Radio	19% (6)	31% (10)	<b>38% (12)</b>	12% (4)
National Newspaper	12% (4)	<b>31% (10)</b>	<b>31% (10)</b>	25% (8)
School Events TV	26% (8)	<b>45% (14)</b>	19% (6)	9% (3)
Regional Newspaper	16% (5)	25% (8)	<b>38% (12)</b>	22% (7)
Situation Comedies	19% (6)	<b>50% (16)</b>	25% (8)	6% (2)

### **Pre-service Teachers Perceptions of K-12 Students**

Pre-service teachers were also asked about their insights regarding how K-12 students most frequently studied about social issues. Pre-service teachers indicated that they believed “teacher talk” to be the most

frequent method by which K-12 students study or learn about social issues. Sixty-seven percent of the students believe that this technique is used always or frequently as a means to teach social issues. In contrast, only 38% (always/frequently) of the respondents indicate they believe that students are given the opportunity to work on community service projects tied to specific social issues being studied in school. With the exception of “teacher talk,” all of the responses ranged from 25% (always/frequently) to 45% (always/frequently). Reading about social issues either in textbooks, journals/magazines, or books were seen as the least likely manner by which K-12 students learn about social issues (see Table 5).

**Table 5**

The Most Frequent Way Students K-12 Students Study/Learn About Social Issues

	<b>Never</b>	<b>Sometimes</b>	<b>Frequently</b>	<b>Always</b>
A teacher talks about social issues in class.	0% (0)	34% (11)	<b>56% (18)</b>	9% (3)
Students read about social issues in an article or journal.	12% (4)	<b>62% (20)</b>	25% (8)	0% (0)
Students write papers about social issues.	3% (1)	<b>62% (20)</b>	31% (10)	3% (1)
Students read about social issues in books (other than textbooks).	9% (3)	<b>62% (20)</b>	25% (8)	3% (1)
Students read about social issues in textbooks.	0% (0)	<b>59% (19)</b>	34% (11)	6% (2)
Students complete projects on social issues.	3% (1)	<b>52% (16)</b>	32% (10)	13% (4)
Students participate in field trips related to social issues.	6% (2)	<b>50% (16)</b>	28% (9)	16% (5)
Student's work on community service projects tied to specific social issues being studied in school.	6% (2)	<b>56% (18)</b>	19% (6)	19% (6)

### Pre-service Teachers Experiences

Pre-service teachers were also asked about their own experiences in programs that focused on community service. Sixty-seven percent of the respondents indicated that they did have community service programs in their K-12 schools and 82% indicated that they personally had participated in community service projects (see Table 6). Additionally, pre-service teachers were asked which social issues (selected from a list) they were most concerned about. Child abuse, violence, abortion, discrimination, spousal battering and poverty prevailed as the issues that students felt very concerned about. Issues of nuclear proliferation and nuclear power (48% and 45% respectively) elicited responses demonstrating that students were either not concerned or only somewhat concerned about (see Table 7).

**Table 6**

Community Service Programs and Participation

	<b>YES</b>	<b>NO</b>
Did your school (k-12) have any community service programs?	<b>67% (22)</b>	33% (11)
Have you personally participated in any community service programs?	<b>82% (27)</b>	18% (6)

Key to understanding these pre-service teacher's perceptions are the courses they report as having impacted them in with regard to social issues. The respondents were very clear about detailing those courses instrumental in shaping their social consciousness. Pre-service teachers indicated that U.S. History, World History, American Literature, Government, English, World Literature, Earth Science and Current Events courses were most influential with respect to their treatment of social issues. All of these courses ranged between 57% and 81% of the pre-service teachers indicating either a great deal of impact or some impact. None of the courses listed had more than 45% of the students indicate that the course had a great deal of impact regarding social issues (current events). Except for Earth Science, all other science courses listed (including mathematics) were perceived as having either no impact or very little impact on the pre-service teachers relative to social issues. In fact, 84% of the pre-service teachers indicated that Chemistry had either no impact or very little impact (42% indicating no impact). Forty-two percent indicated that Physics had no impact and not a single pre-service teacher indicated that Physics

had a great deal of impact. Physics was the only course listed for which no students indicated that the course had a great deal of impact. Nearly an equal number of students indicated that biology had no impact or very little impact as those who indicated that biology had some impact or a great deal of impact (see Table 8).

**Table 7**  
Social Issues Students Are Most Concerned About

Issue	Not Concerned	Somewhat Concerned	Concerned	Very Concerned
AIDS	0% (0)	9% (3)	<b>55% (18)</b>	36% (12)
Discrimination	0% (0)	6% (2)	30% (10)	<b>64% (21)</b>
Child Abuse	0% (0)	0% (0)	6% (2)	<b>94% (31)</b>
Violence	0% (0)	0% (0)	21% (7)	<b>79% (26)</b>
Abortion	3% (1)	15% (5)	12% (4)	<b>70% (23)</b>
Gangs	0% (0)	6% (2)	45% (15)	<b>48% (16)</b>
Poverty	0% (0)	3% (1)	30% (10)	<b>67% (22)</b>
Water Pollution	3% (1)	21% (7)	<b>45% (15)</b>	30% (10)
Air Pollution	0% (0)	24% (8)	<b>45% (15)</b>	30% (10)
Global Warming	9% (3)	21% (7)	<b>48% (16)</b>	21% (7)
Land Use	3% (1)	24% (8)	<b>48% (16)</b>	24% (8)
Ozone Depletion	3% (1)	30% (10)	<b>42% (14)</b>	24% (8)
Spousal battering	0% (0)	15% (5)	18% (6)	<b>67% (22)</b>
Censorship	0% (0)	27% (9)	<b>36% (12)</b>	<b>36% (12)</b>
Nuclear Proliferation	15% (5)	<b>33% (11)</b>	<b>33% (11)</b>	18% (6)
Nuclear Power	15% (5)	30% (10)	<b>36% (12)</b>	18% (6)
Other	18% (4)	9% (2)	<b>41% (9)</b>	32% (7)

**Table 8**  
Courses that Have Had an Impact on Students in Regard to Social Issues

Course	No Impact	Very Little Impact	Some Impact	A Great Deal of Impact
US History	9% (3)	21% (7)	<b>48% (16)</b>	21% (7)
World History	12% (4)	15% (5)	<b>45% (15)</b>	27% (9)
American Literature	0% (0)	27% (9)	<b>55% (18)</b>	18% (6)
Foreign Language	18% (6)	<b>33% (11)</b>	30% (10)	18% (6)
Government	3% (1)	15% (5)	<b>42% (14)</b>	39% (13)
English	6% (2)	27% (9)	<b>58% (19)</b>	9% (3)
World Literature	18% (6)	24% (8)	<b>36% (12)</b>	21% (7)
Current Events	15% (5)	6% (2)	33% (11)	<b>45% (15)</b>
Math	33% (11)	<b>52% (17)</b>	9% (3)	6% (2)
Chemistry	<b>42% (14)</b>	<b>42% (14)</b>	12% (4)	3% (1)
Earth Science	12% (4)	24% (8)	<b>52% (17)</b>	12% (4)
Physics	<b>42% (14)</b>	33% (11)	24% (8)	0% (0)
Biology	9% (3)	<b>39% (13)</b>	27% (9)	24% (8)
Health	12% (4)	33% (11)	<b>36% (12)</b>	18% (6)
Art	27% (9)	21% (7)	<b>36% (12)</b>	15% (5)

Eighty-two percent of the pre-service teachers indicated that they had studied about social issues in a K-12 setting. An overwhelming 97% of respondents deemed studying about social issues in school important and 70% indicated that their classes in school have prepared them to address social issues. The

pre-service teachers responding to the survey indicated that courses they have taken have had an impact on them regarding social issues (85%) and that understanding social issues as you mature into adulthood is important (100%). Respondents also indicated that there were social issues that they would like to have studied about in school, had they been given the opportunity. Furthermore, they expressed their interest in working on a social issue now (see Table 9).

**Table 9**  
Perceptions of School, Courses and Social Issues

	<b>YES</b>	<b>NO</b>
Have you, as a k-12 student, ever studied about social issues in school?	<b>82% (27)</b>	18% (6)
Do you think studying about social issues in school is important?	<b>97% (31)</b>	3% (1)
Have your classes in school prepared you in any way whatsoever to address social issues?	<b>70% (23)</b>	30% (10)
Have you taken any courses that have had an impact on you in regard to social issues?	<b>85% (28)</b>	15% (5)
Is it important to be able to understand social issues as you mature into adulthood?	<b>100% (33)</b>	0% (0)
Are there any social issues you would like to have studied about in school, but did not get the opportunity to do so?	<b>79% (26)</b>	21% (7)
Would you be interested in working on a social issue now?	<b>88% (29)</b>	12% (4)

### **Impact on Social Issues by K-12 Students**

Pre-service teachers were asked to consider K-12 students with attention to the extent to which they anticipated those students as being capable of influencing social issues. From a list on the instrument, students were asked direct questions for each issue as it pertained to the possible impact K-12 students might actualize. For all issues, more than 60% of the pre-service teachers judged K-12 students capable of having an impact on the issues. For all but two issues, nuclear power and nuclear proliferation, over 88% of the students believed K-12 students could impact the issue. For discrimination, AIDS, violence, and gang activity, 100% of the pre-service teachers believed that K-12 students could impact the issue.

**Table 10**  
Perceived Impact on Social Issues: Which Issues Can K-12 Students Impact?

<b>Social Issue</b>	<b>YES</b>	<b>NO</b>
Discrimination	<b>100% (33)</b>	0% (0)
AIDS	<b>100% (33)</b>	0% (0)
Violence	<b>100% (33)</b>	0% (0)
Abortion	<b>91% (30)</b>	9% (3)
Child Abuse	<b>97% (32)</b>	3% (1)
Air Pollution	<b>94% (31)</b>	6% (2)
Land Use	<b>88% (29)</b>	12% (4)
Water Pollution	<b>97% (32)</b>	3% (1)
Global Warming	<b>94% (31)</b>	6% (2)
Gang Activity	<b>100% (33)</b>	0% (0)
Ozone Depletion	<b>94% (31)</b>	6% (2)
Poverty	<b>94% (31)</b>	6% (2)
Spousal Battering	<b>79% (26)</b>	21% (7)
Censorship	<b>88% (29)</b>	12% (4)
Nuclear Power	<b>64% (21)</b>	36% (12)
Nuclear Proliferation	<b>64% (21)</b>	36% (12)

With that in mind, we also asked the pre-service teachers where they believed they could impact social issues. Eighty-two percent of the respondents indicated that they could have a great deal of impact on those social issues affecting immediate family. Only 61% indicated that they could have a great deal of impact on social issues prevalent in the community in which they live. Less than 20% of the pre-service teachers believed that they could have a great deal of impact on social issues at the state, national, or global scale. In fact, many of the pre-service teachers believed that they could have little or no impact on those issues that are evident at the state, national, and global level (see Table 11).

**Table 11**  
Student Perceptions of Where They Can Impact Social Issues

Category	No Impact	Very Little Impact	Some Impact	A Great Deal of Impact
Social issues that affect your immediate family.	0% (0)	3% (1)	15% (5)	<b>82% (27)</b>
Social issues that are evident in your immediate community.	0% (0)	6% (2)	33% (11)	<b>61% (20)</b>
Social issues that are evident on a state level (which may or may not be in your community).	0% (0)	31% (10)	<b>50% (16)</b>	19% (6)
Social issues that are evident on a national level (which may or may not be evident in your community).	3% (1)	<b>42% (14)</b>	36% (12)	18% (6)
Social issues evident on a global scale (which may or may not be evident in your community).	12% (4)	36% (12)	<b>39% (13)</b>	12% (4)

## Discussion

Rubba & Harkness (1993); Yager and Lutz (1995); and Yager, (1996) gave some specific reasons why social issues should be integrated in the science curriculum: it allows students to find science classes relevant to their daily lives; it enables teachers to evaluate student success at the level of application and synthesis of ideas; it redefines the teacher's role as facilitator, and relegates the textbook's status to an information source; it may allow for increased scientific understanding of concepts, based on cognitive theories of learning; and, it provides a vehicle for tying the school program together. It would seem that such evidence would be sufficient to ensure that social issues are valued as a critical part of the science experience for all students. Yet, our pre-service teachers lack exposure to social issues in the majority of their science experiences. Not surprisingly, pre-service teachers indicated that parents, teachers, and friends, as well as local, regional, and national media provide the information on which they form opinions regarding social issues. These results bring to light the question of the accuracy and reliability of these sources. Are they unbiased? Are the pre-service teachers learning how to discern between opinion and fact and are they able to use this information to make informed decisions regarding particular social issues? Will they incorporate the study of social issues into their classrooms based on their own experiences? Will they assume that their K-12 students will rely on the same types of sources to gain information on social issues? The results garnered by the current study are similar to the results that Totten and Pedersen (1996) previously shared concerning high school students on a national scale. Although at a much lower level (about 12%), high school students overwhelmingly indicated that science was not the area of study that provides information about social issues. Rather, that study established that friends, parents and teachers, as well as local, regional and national media are key sources of information regarding social issues. It would appear that although there is a perceived importance for the study of social issues in schools (Pedersen and Totten, 2001), little is being done within schools to ensure that all children have an opportunity to engage in a thorough study of issues pertinent to their personal lives.

Even though K-12 students and pre-service teachers report that science courses are not a key or very important source of information regarding social issues, teachers of science report feeling comfortable teaching social issues—believing both in the efficacy of their ability to teach social issues and in the necessity to infuse a discussion of social issues into the extant curriculum (Totten and Pedersen, 2001).. How is it that teachers believe that social issues should be part of the science curriculum, yet students and

pre-service teachers all indicate that their experiences in schools are bereft of encounters with the study of social issues? Fensham (1988) offers some insights into this dilemma. Providing evidence that when STS is integrated into science curricula, Fensham (1988) found that most teachers are simply adding on a brief social context within regular science content rather than providing a deep study of the issue as it relates to science within the larger social, political, and moral context of the community. Rubba (1989) expressed similar concerns. His research showed that there were not significant differences between science teachers who claimed to integrate STS in science courses and traditional science teachers who commonly taught using lecture and lab format with some technological tools. Pedersen and Totten (2001) also discovered that almost 70% of the teachers in their study relied on a textbook as their primary source for curricula. This becomes problematic since Rubba and Harkness (1993) found that a large number of textbooks fail to cover social issues, and teachers do not take this into account in their teaching. Science textbooks do not typically include STS topics and teaching practices reflect little recognition of STS themes or instructional strategies for teaching about STS themes (Bybee, 1991).

Sixty-seven percent of the pre-service teachers in the current study believe that students most often (either frequently or always) learn/study about social issues from a teacher talking about the social issue in class. With far less frequency, pre-service teachers indicate that they believe students read about social issues in textbooks, take field trips related to social issues, and complete projects about social issues (40%, 45%, and 44% respectively either frequently or always). Totten and Pedersen (1996), in their study of high school students, arrived at a similar conclusion. That is, "teacher talk" is indeed the most common manner by which high school students studied and learned about social issues.

The dilemma according to Bybee (1991), Rubba and Harkness (1993) and Pedersen and Totten (2001) is that textbooks do not provide a sound basis for the study of social issues in science classrooms. Further more, Aikenhead (1992) suggests that STS instruction should start with a discussion of the societal aspects of an issue; be fundamentally interesting issue either about society, technology, or science, cover technological aspects of a problem; and develop a scientific concept. "[An] STS approach is multidisciplinary in that important skills, concepts, and attitudes associated with STS topics can and should be taught in most areas of the school curriculum" (Heat, 1992; p.54). STS instruction must be comprised of situations that are real, current, and relevant to the content under discussion and of interest to the students. Heat (1992) suggests that STS instruction should begin by "focusing on issues that are current and relevant to student interest and content areas, next, the teacher should engage students in the development of decision-making skills and attitudes and encourages them to make informed judgments about science and technology issues, and then the teacher should integrate instruction and learning from many curricular areas and promote science, technology, and social literacy" (p. 52-53).

How is it that our pre-service teachers and K-12 students all concur that they lack experiences with issues, and rely primarily on "teacher talk" as a means of learning or studying about social issues? Pedersen and Totten (2001) in their study of science teachers indicate that most are not anxious about teaching social issues, in spite of the possible controversy surrounding such discussions. From the same study it appears that teachers do not feel support from their colleagues or from the student's parents. However, these teachers reported that they did believe that their STS rationale was supported by their principals. Berger and Flinders (1990) and Hodson (1998) point out that many teachers avoid facing the political interests or discussing the social values underlying the scientific and technological practice they teach, despite the fact that "This makes little or no sense" (p. 21). Similarly, Levinson, Koulouris, and Turner (2000) report that science teachers in England and Wales feel unable to discuss social issues with students in the classroom, hinting at the scope of this phenomenon. However, it is important that these issues are addressed as teachers come to a new understanding of science in modern society, equipped with the tools required to deal with STS appropriately in the classroom. By way of solution, teachers might listen to the respective experience of their students and focus on the students' culture, thereby creating a conversation in which the cultures of the student and the teacher meet to validate encourage social action (Strehle, 1999).

It would seem that within higher education we have a similar problem in that STS is largely disconnected from the curriculum. Pedersen and Totten (2001) indicate that teachers did not feel their education prepared them to teach social issues in the science classroom. One reason for this lack of understanding could be that STS themes have not been integrated in the science curriculum of higher

education (Kumar & Chubin, 2000). In the current study, pre-service teachers indicate that their science course work—Chemistry, Physics, Biology, and Health—had no or very little impact on them regarding social issues, although they did indicate that earth science had some or a great deal of impact on them. According to the pre-service teachers, even art courses had a greater impact on the pre-service teachers than Biology, Physics, or Chemistry. How can we expect our pre-service teachers to be prepared to teach social issues if the experiences that we are providing within their programs lack a substantial, critical examination of social issues relative to science? The responsibility does not lie entirely within the pedagogical components of the teacher preparation programs in which are students are engaged. Other areas including the natural sciences must do more to integrate STS into the extant curriculum. Presenting a unique challenge to teachers, STS issues are often complex and interrelated to other issues and problems, and student's understanding of the issues often requires that the student already possess specialized knowledge and skills (Heat, 1992). Yet it would seem that higher education would be an ideal place in which to engage our students in the study of complex problems and interrelated issues. At this level of their educational experience, their knowledge base should be more defined and the pre-service teachers should be ready to accept such intellectual challenges. As Tsai (2001) recommends STS instruction should be based on inquiry activities that can develop students' problem-solving skills and encourage them in social negotiations and cooperative learning.

### **Conclusions and Recommendations**

The changes in society and in science and technology, and the disconnection between them, have forced a reconstruction of the objectives in the teaching of science. Yager (1990) explained that the idea behind the STS should be to provide a real-world connection for the student between the classroom and society. STS instruction should offer an opportunity to identify controversial problems, to collect data with regard to the problem, to consider alternative solutions, and to judge the outcomes based on particular decisions. Therefore, students have an opportunity to become proficient at problem solving. It is time that higher education preparation programs acknowledge their responsibility and contribute to the building of social consciousness throughout the pre-service course of study—including within the study of natural science. Instructors and professors should engage pre-service teachers in complex and interrelated issues and problems that challenge them intellectually and prepare them to be problem solvers. As part of this process, instructors should also infuse STS experiences (e.g., community based service programs) into the science curriculum, and use essay examinations, performance based assessments, and portfolios as methods of assessment in STS units (Cheek, 1992).

Absence of STS interactions in science education provides one explanation for the lack of interest among students for the study of science. Significantly, there are many teachers who ignore these aspects when analyzing materials used routinely in science classes. Furthermore, for many elementary teachers, science as a subject area is ignored or relegated to the last minutes of an instructional day. If a majority of teachers do not consider interactive STS aspects a necessary element, then it would seem evident that we do not transmit a complete and contextualized vision of science to our pre-service students.

We believe, as Bybee (1991) asserts, that “all pre-service teachers should be engaged in a study of science that is: (a) relevant and applicable to the lives of students; (b) related to their social maturity and cognitive development; (c) relative to the importance of the topic in the world today and that it will remain important for a significant portion of the students lives; (d) potentially transferring knowledge to contexts other than the current subject or course; and, (e) within pre-service teachers' interest and enthusiasm for the topic and its inclusive issues” (p. 56). More needs to be done in higher education to provide pre-service teachers with experiences that not only engage them in the study of social issues, but also equip them with workable models of how they might integrate STS within the extant science curriculum.

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