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Exploring science teachers' attitudes and knowledge about environmental education in three international teaching communities

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This study examined the similarities and differences among 171 Grade 7-12 science teachers from three different countries (54 U.S, 63 Bolivian, and 54 Turkish) with respect to their attitudes toward environmental education (EE) and instructional practices. The instrument employed explored how teachers' knowledge, instructional practices, decision-making process, and cultural features influenced their EE attitudes and praxis. The instrument, which was translated into Spanish and Turkish and then back into English, contained a personal data form that included demographic questions and a three-part questionnaire. Based on the analysis completed, significant differences were found between these three countries with respect to 1) teacher's knowledge about global environmental issues, 2) teachers rationales for including environmental education in their science classroom instruction, and 3) while there were no significant differences in the importance of religion in the teachers lives, there were significant differences in the extent to which teachers reported religion influencing instructional decisions. In addition, there were differences regarding the resources that teachers reported drawing on as they included EE in their classrooms. There were no significant differences found when comparing the three countries with respect to extent to which each country reported including technological and/or environmental problems in science classroom instruction. Finally, generally there was agreement regarding teachers' goals and objectives in science classrooms with respect to EE and the most important global environmental problems/threats.

Keywords: environmental education, in-service teachers, global environmental issues, international science education, ecosystem

Introduction

Environmental Education holds a unique place in formal public education. While most agree that it is logically compatible with other science disciplines in science education, it is not typically afforded the singular focus in most nations' science standards documents that other more central disciplines of science receive (i.e. chemistry, biology, physics, and earth science). As an example, in the United States (U.S.) the National Science Education Standards (NRC, 1996) outlines eight content standards. Of these eight standards, physical, life, and earth and space science are elevated to the central foci of three of these standards, while Environmental Education (EE) is not included as a central focus. Constructs of EE can be found in the *Science and Social and Personal Perspectives* content standard, but it seems included as periphery at best.

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When considering the importance and objectives of EE the United Nations Environmental, Scientific, and Cultural Organization (UNESCO) articulated the following:

> The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones (1975, p.3).

Most nations globally are cognizant of the importance of EE and as such have charted approaches to its inclusion in formal education. These charted approaches vary greatly. In Latin American nations, for example, integrating EE into formal education, if it is integrated at all, has been greatly thwarted by teacher quality concerns where EE experiences of most students is reduced to the mastering of isolated bodies of knowledge (González-Gaudiano, 2007; Gray, 1999; Penwell, Cronin-Jones, Hakverdi, Cline, & Johnson, 2002), a strategy judged not effective by most in science education (AAAS, 1989; NRC, 1996). In Turkey EE is in its infancy and has been found lacking in public schools when compared to private school counterparts (Tuncer, Ertepinar, Tekkaya, & Sungur, 2005). Finally, in the U.S. EE, for the most part, has been relocated to informal educational spaces due to 1) a narrowing of curriculum that some link to the testing culture brought about by the No Child Left Behind Act (2001) and 2) EE's lack of inclusion in national and state standards. This research emerged in an effort to better understand the similarities and differences of the varying approaches to EE on the attitudes and praxis of science teachers. The primary goal of this research is to elucidate attitudes and praxis of science teachers in light of the charted EE approaches taken in different countries. In addition, the study also provides discussion about what environmental educators from each country should consider in their efforts to ensure that the next generations of citizens receive the intended benefits of EE as part of their formal education.

In an effort to examine the similarities and differences between science teachers' attitudes and self-reported instructional practices in EE, science teachers from three countries, Bolivia, Turkey, and the U.S., were included in this study. The following seven research questions were examined to provide nuanced information about science teachers' attitudes and reported instructional practices when considering environmental education:

1. To what extent are science teachers familiar with technological and/or environmental problems discussed at the 2007 Bali-Indonesia United Nations Climate Change Conference?
2. What rationales are offered by science teachers for including or not including technological and/or environmental threats to the environment in science classroom instruction?
3. To what extent do science teachers report including technological and/or environmental problems in science classroom instruction?
4. What are the main sources of information that teachers use for attaining information about environmental problems/threats?
5. What do teachers think is most important to teach in science classes?
6. What do science teachers perceive as the most significant problem or threat to the environment?
7. What role does religion play in science teachers' decisions about teaching environmental issues in a science classroom?

Background

Environmental Science Education Internationally and in the U.S.

Currently, and at least in the United States, considerable attention and support have been given to the need to bring Environmental Education (EE) back into American classrooms. For instance, the North American Association for Environmental Education (NAAEE, 2009) strongly advocates both the National Environmental Education and the No Child Left Inside acts in an effort to provide EE with the necessary funding and policy-based support that could make EE instruction a regular practice in the American education system. Arguments surrounding the case for EE point to the loved and hated No Child Left Behind act (No Child Left Behind [NCLB], 2001) as the culprit of the disappearance of EE from the school curricula. It has been noted for instance that the NCLB was the focus of the current education reform and no provisions were allocated to sustain EE that could have been embedded in the NCLB act.

Both international (The Tbilisi Declaration, [UNESCO-UNEP, 1987]) and National (North American Association of Environmental Education [NAAEE], 2009) organizations agree in that the EE's goal should be focused on three fundamental aspects: (1) building awareness among individual citizens and community groups about the impact of the social, economic, political, and ecological practices on the environment; (2) providing education opportunities for citizens so they acquire the necessary skills, knowledge, values and attitudes for the protection of the environment, and (3) fostering action-oriented behaviors towards environmental conservancy and sustainability. Others (Palmer & Neal, 1994; Jeronen, Jeronen, & Raustia, 2008) have submitted similar views on the goals that EE should accomplish in both formal and informal educational settings.

A common theme that has appeared in the EE literature over the last three decades is the assessment of environmental-oriented attitudes among students, educators and the general public, although with more prevalence in most developed countries. In 1978, Dunlap and Van Liere designed one of the most known instruments to measure pro-environment attitudes that they called the New Ecological Paradigm (NEP). Later, in 2000, Dunlap, Van Liere, and Mertig, and Jones suggested an improved version of the original instrument which now they call the New Ecological Paradigm Scale (NEPS). The improved version contains an updated terminology, presents balance between pro and anti environmental items, and most importantly accounts for a wide environmental worldview. Research about the views and attitudes pre-service teachers hold about EE has been quite frequent in the literature. Desjean-Perrotta, Moseley, and Cantu (2008) used drawings and sentence completions to explore how pre-service elementary teachers' perceive environmental issues. The authors found that this group of teachers lack the knowledge necessary that would allow them to be considered environmentally literate according to the NAAEE' s guidelines for the initial preparation and professional development of environmental educators. In their study the authors did not find a significant influence of both ethnicity and residential program. Others (Zack & Munson, 2008) corroborated these findings by citing pre-service teachers' lack of conceptual understanding of major ecological concepts. Similarly, Pe'er, Goldman, and Yavetz (2007) reported limited environmental knowledge among pre-service teachers from three higher education institutions; however their overall environmental attitudes were positive. The authors observed a correlation between environmental knowledge and environmental attitudes. For instance, students majoring in disciplines related to the environment demonstrated more knowledge about the environment along with environmental oriented attitudes as compared to students from other fields. These findings are in correspondence with Arcury's (1990) views in that "Increased knowledge about the environment is assumed to change environmental attitudes" (p. 300). It was also observed that both environmental knowledge and

environmental attitudes have a positive influence on environmental policy initiatives. There have also been studies in the environmental education literature focused on in-service teachers' understanding of key environmental issues (Boyes, Chambers, Stanisstreet, 1995; Groves & Pough, 1999; Summers, Kruger, & Childs, 2000; Zak & Munson, 2008). Nevertheless, few of these studies have been conducted with secondary school teachers (Liarakou, Gavrilakis, & Flouri, 2009), and even a smaller amount of research has integrated cross-national studies (Guisasola, Robinson, & Suza, 2007).

A main concern among educators and researchers is the lack of consistency in the practice of conservancy and sustainability practices among the public, including students. A robust body of literature has been dedicated to the exploration of pro-environmental attitudes. Stern and Dietz (1994) investigated this issue from the Person's Value System framework. In their view, the development of environmental-oriented behaviors depends on the value system people assign to themselves, to others and to fauna and flora resources. Similarly, Wesley-Shultz (2000) suggests that environmental concerns are formed only when people see themselves as an integral part of nature. Others state that this lack of favorable attitudes is the result of individualistic postures adopted as people put themselves first over communal and environmental goals (Hartig, Kaiser, & Bowler, 2001). Similar studies have been conducted with members of immigrant communities (Penwell et al., 2002) in which acculturation and enculturation elements have been the focus of these studies, and also in Less Developed Countries (LDC) (González-Gaudiano, 2007; Gutiérrez & Priotto, 2008).

Stern (2000) points out that historically human environmental impact is connected to a variety of human necessities and desires, he cites for instance the "desire for physical comfort, mobility, relief from labor, enjoyment, power, status, personal security, maintenance of tradition and family, and so forth" (p. 408). A review of a series of studies conducted by De Young (2000) was aimed at examining the effectiveness of intrinsic satisfaction as a strategy to promote Environmentally Responsive Behaviors. The author argues that both frugality and participation, two categories within the intrinsic satisfaction strategy, supports the development of skills and abilities useful in taking care of the planet. Environmentally Responsive Behaviors consist of a set of indicators that can be used to document two aspects: a change in the accessibility to energy resources derived from the environment, and changes in the makeup of ecosystems and the biosphere. In the same vein, Kaplan (2000) refers to possible failures one could encounter when fostering Environmentally Responsive Behaviors. For instance, he points out that instead of telling people (students) what to do in regard to pro-environmental attitudes, a more responsive approach should emphasize culturally responsive ecological actions. In his view, this approach would take into account local variants such as culture, needs and motivation in the community, and the participation of local residents as members of the team in charge of addressing the problem. In Kaplan's view (2000), ecological activities should be founded on the need to "recognize and work with the motivations of the local community, treat human capacity as a resource, and engage the powerful motivations for competence, being needed, making a difference, and forging a better life" (p. 505).

Nevertheless, and in correspondence with Kaplan's view, it is important to examine what he calls 'local variants' that may greatly affect the implementation of EE programs. This is of great relevance in LDC communities where residents of under-served populations are forced to make their living on by continuously exploiting natural resources. Such is the case of some Caribbean countries whose governments, although acknowledge the value of establishing EE programs, do not have the means to support and sustain EE practices (Gutiérrez & Priotto, 2008; Penwell et al., 2002). International initiatives and regulations although well intended, may not be applicable in LDC due to local barriers that emerge from socio-economic realities experienced by these

communities. Therefore, they become ineffective and quickly forgotten. Gutiérrez and Priotto (2008) contend that pro-environmental initiatives have received a mixed acceptance on the part of each sector of the society, especially in the education and political systems. It seems that everyone internalizes new regulations in different ways in accordance to their own needs and interests. A cluster of studies (Čapek, 1993; Clayton, 2000; Perrolle, 1993) have tapped into the roles of gender, race and class to better understand how citizens interrelate with the environment. These studies are characterized by an Environmental Justice (EJ) focus which illuminates the links between justice and environmental issues. The rationales for this approach reside in that (1) the relevance of justice depends on the way in which one thinks about resources, (2) justice becomes an issue when environmental benefits or hazards are related to group identities, and (3) responsibilities and moral obligations with the environment become relevant as citizens learn about their severe and permanent impacts on the natural environment (Clayton, 2000).

Education programs, in both formal and informal settings continue to be seen as the target to empower EE initiatives. Teacher education programs for instance have introduced environmental education courses, enriched with current ecological movements such as 'green citizenship,' and energy-related pro-environmental practices. However, these efforts are rendered inappropriate when educators do not find a niche for their EE ideas. Currently, in the U.S. over 800 environmental organizations have come together in trying to get the No Child Left Inside act funded by the government, and with it receive the needed federal support to incorporate EE as a regular subject in the school curricula. Similar barriers are experienced by educators in other countries where a lack of training, resources and materials are the main concerns (Penwell et al., 2002).

Environmental Science Education in Latin America

Environmental education (EE) has been in the Latin American educational landscape since the 1970s. The first efforts to introduce it were in the form of informal education programs, most of them linked to popular and rural movements (González-Gaudiano, 2007). Other ways to disseminate EE were in the form of informational meetings for the public (Penwell et al., 2002). However, and after over three decades of its implementation, EE has not rendered the expected outcomes that educators, and government officials from these nations hoped to see materialized. It is believed that, not only EE practices, but also the whole education system is affected by a myriad of elements that make any novel program a formidable task for schools. González-Gaudiano (2007) and Gray (1999) agree in that education in Latin America suffers from a scarcity of resources, low economic investment in this sector, flaws in teacher education (most elementary school teachers in rural communities have no more than a high school degree), high dropout rates, lack of teaching supplies to implement the mandated programs, teaching loads that require educators to work with multiple subjects and grade levels, and lack of quality instructional materials; even the social status teachers enjoy—which is reflected in their salaries—has a detrimental effect on the job quality observed in schools, especially in the public sector (Penwell et al., 2002). It seems then that teaching under these circumstances does not guarantee exemplary education practices, instead teaching students how to master isolated bodies of knowledge is the most affordable task teachers perform. It is commonly assumed that education quality in K-12 Latin American schools is reserved for those students whose parents can afford the pricy tuitions at private institutions. Therefore, for some there is hope in that private schools may lead the way in the adoption of meaningful initiatives that could revitalized the state of EE in the region.

In Latin American schools, forces such as "social inadequacies and malfunctions, social inequalities and the agendas of modernity and globalization" (González-Gaudiano, 2007, p. 155) have caused the environmental education movement to lack pedagogical identity. It is also typical

to see how EE programs have mirrored the fate of other well-intended educational endeavors that have quickly come and gone due to the new politics enforced by each new government. It is noted that EE imported curricula should be usable under the features characterizing local contexts and problems. Technical documents centered on a scientific perspective should present EE instructional materials that address holistic approaches to problems, multi-contextual and action-oriented purposes that would well serve local contexts and school communities. Such is the case of the EE programs that emerge from international summit conferences and have little or no effect in Latin America due to its dismal figuration in international decision making panels (González-Gaudiano, 2007). At the internal level, the EE discourse in Latin American countries is tinted with a mix of postures coming from different interest groups, both from national and overseas which produces an unsupported mindset on the part of the agents responsible for leading the action taking processes.

As in many industrialized nations, EE in Latin American countries has been reduced to almost informal educational spaces in the school curriculum. A more delicate situation is experienced in other countries of the region where EE has become irrelevant in the school curriculum. Harsh socio-economic circumstances that impose tough daily survival conditions have forced local residents to increasingly destroy natural resources as their only way to make a living. This harsh reality goes hand-in-hand with the status of Latin America in the global environmental landscape; its human population growth rates have positioned the region on top ranks with four of the most populated cities in the world.

Environmental Science Education in Turkey

Tuncer, Ertepinar, Tekkaya, and Sungur (2005) declare that Environmental Education (EE) in Turkey is in its infancy or "just beginning" (p. 216). Because one-third of the Turkish population are young, with one-sixth of the total population participating in the nation's eight years of obligatory primary education, the 'beginning of EE' in Turkey is focused almost exclusively on primary education interventions. As with Latin American and the U.S., EE is not taught in a stand-alone course, but instead is included in the content of other more central disciplines. Like many countries, Turkey has a national curriculum that is controlled by the Ministry of Education. While little attention is devoted to EE at the high school level, there is an elective course, *Environment and Human*, but this is an option that allows students to opt out if they choose.

Just as problems with EE in the U.S. and in Latin America have been identified, Gokdere (2005) and Tuncer, Ertepinar, Tekkaya, and Sungur (2005) identified 1) inconsistencies in the goals and principles in EE, 2) financial shortfalls in support of EE, and 3) shortages of qualified teachers trained in EE. Similar to Latin American schools, differences can also be found between public and private schools in Turkey. Private school students have been found to be more aware of global and national environmental problems, solutions to the environmental problems, and aware of their individual responsibility (Tuncer, Ertepinar, Tekkaya, & Sungur, 2005). These differences are thought related to financial advantages found in private schools where support can be leveraged to lure better prepared teachers and physical facilities are superior.

Given the many different influences levied on teachers from each of the three countries being investigated, this research was thought to be that much more important. Fraser (1996) articulated the following reasons to support educational research across national boundaries: 1) there exists a greater variability in factors influencing classroom environments and 2) insight is provided about other countries, while insight into the classroom environment of the researchers' own country is sharpened. This research was completed with these factors and advantages in mind.

Methods

Context

Data for this study came from one hundred seventy-one 7-12th grade science teachers (54 U.S, 63 Bolivian, and 54 Turkish). The data sampling is classified as a convenience sample because all three groups were taken from national regions accessible to the researchers in the U.S. Bolivia, and Turkey. For instance, Bolivian teachers were contacted via a non-profit education organization prior to their participation in a teacher summer institute. All Bolivian participants represent the six school districts of the country capitol metropolitan area, work for public schools only, and their teaching experience ranges from four to twenty years. In the U.S. the teachers surveyed participated in a summer professional development courses offered by their state office of education. In Turkey the teachers who participated in this study were drawn from three city centers from east part of Turkey. As with teachers in Bolivia, the science teachers surveyed from Turkey and the U.S. worked in public schools. Additionally, the Turkish and U.S. teachers had comparable ranges of experience as those identified in Bolivia. The rationale for the selection of teachers from these three nations is based on the unique economic and socio-cultural features characterizing these nations and their education systems. It was thought that in times of globalization these distinctive factors would allow for the exploration of the nature and depth of knowledge and attitudes about the role environmental education plays in schools around the world. The surveys completed by the teachers were in Spanish, Turkish, or English, depending on the sample. The number of teachers sampled, as well as the convenience sampling was recognized as potential limitations to this study. But, the researchers believed that much could be gained from comparing these convenience samples as long as these limitations were made transparent and any conclusions were made in this context.

Demographics

Bolivia: The traditional notion that foreigners may have about Bolivia focuses on "media portrayals of the cocaine trade and a vague awareness of Indians and llamas" (Luykx, 1999, p. xi), and more recently on political tensions with the United States that are linked to internal outburst of violence in the northern states. Currently, ambassadors of both countries have been removed until political relationships get reestablished. Bolivia is much more; it is a multi-ethnic and a multi-lingual country. While 60% of the people speak Spanish, since 1999 the government has also recognized Quechua, Aymara, and Guaraní, and over 33 other indigenous languages. This country also has a great geographical diversity, including the Andes Mountains, the *altiplano* (Plateau region), the pampas (plains), and the Amazon Basin jungle. Bolivia still maintains one of the highest poverty rates in Latin America. Taking into account income rates, 63 percent of Bolivians are poor, an indicator that is well above that of the region, which is 36 percent (Contreras & Talavera-Simoni, 2003). Much of the social division has been the product of the distance separating the poor indigenous majority and the elite *criollo* minority, and the small middle class *mestizo* group in between, aligning, depending on the circumstances, with either of the first two groups (Luykx, 1999). In the 2008 Human Development Index (HDI), Bolivia ranks 111th out of 179 countries with respect to the human development, this is a measure that "provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrolment at the primary, secondary and tertiary level) and having a decent standard of living (measured by purchasing power parity, PPP, income)". Considered within this ranking, Bolivia ranks 124th (65.1% in life expectancy), and 69th (89.8 %) in adult literacy among 179 countries.

U.S.: The United States is considered one of the world's major world powers exerting both positively and negatively perceived influence on the world. The most recent Pew Global Attitudes Project (2007), revealed that "Anti-Americanism is extensive, as it has been for the past five years. (p. 1)". This is due in large part to U.S. foreign policy decisions such as recent military operations in Afghanistan and Iraq. While the sentiment toward the U.S. is varied across the globe, this sentiment is quite negative when considering, Turkey's, as well as other predominately Muslim nations, attitudes toward the U.S., with favorable views from Turkey in the single digits (9%) (PEW, 2007). According to this same project, Bolivians hold a somewhat higher view toward the U.S., but this is still found lacking with more holding unfavorable views of the U.S. (52%). When considering U.S. diversity, according to Fearson (2003), the U.S, while not as ethnically or culturally diverse as Bolivia, it is more ethnically diverse than Turkey while found to be comparably culturally diverse. Also similar to Boliva, the U.S. has a great geographical diversity, including the eastern and western coastlines, mountain ranges from the east coast (Appalachian) to the west coast (Rocky and Cascade). When considering Poverty levels, Bradley, Huber, Moller, Nielson, and Stephens, (2003) declare that the U.S. has a high relative poverty when compared to other industrialized countries, indicating a high degree of inequality in the U.S. In the 2008 Human Development Index (HDI), the U.S. ranks 15th out of 179 countries with respect to the human development. Considered within this ranking, the U.S. ranks 31st (78.0% in life expectancy), and 20th (92.4 %) in adult literacy among 179 countries.

Turkey: While there are many diverse views of Turkey depending on whose perspective is tapped, it is clear that Turkey is unique. One leading member of the Turkish Parliament, Egemen Bagis (Perkovich, Bagis, Elekdag, & Aktan, 2007) characterized Turkey "as a hub and bridge of cultures, religions, geographies, and international political economies". Whether discussion revolves around the European Union candidacy of Turkey or the friction regarding the secular/religious governmental influences, it is clear that this country is quite unique in comparison to most Middle Eastern as well as European countries. In comparison to Bolivia, it is less ethnically and culturally diverse, while in comparison to the U.S., it is less ethnically diverse, but similar with regards to cultural diversity (Fearson, 2003), blending Eastern and Western world cultures. Comparable to the other countries examined in this research, Turkey also has a distinctively diverse geography. It is found geographically between Anatolia and the Balkans with high mountains on the east. Additionally, it is bordered by the Black Sea to the north, the Aegen Sean to the west and the Mediterranean Sea to the south. According to UNICEF (2007), "Turkey is not a poor country by global standards, although the Turkish Statistical Institute (Turkstat) found that a fifth of the population were at risk of poverty in 2005". In the 2008 Human Development Index (HDI), Turkey ranks 76th out of 179 countries with respect to the human development. Considered within this ranking, Turkey ranks 87th (71.6% in life expectancy), and 106th (71.1 %) in adult literacy among 179 countries.

Data Sources

A personal data form and a modified version of a questionnaire created by Guisasola, Robinson and Suza (2007) was used to collect the data for this research. The personal data form consisted of demographic questions concerning teachers' gender, age, degree, and courses taught, to name a few. The modified version of the Guisasola, Robinson and Suza (2007) questionnaire consisted of the original two parts plus one additional part created for this research. Researchers and faculty members with competency and expertise in science and science education justified the content validity of the original version of the questionnaire (Guisasola, Robinson, & Suza, 2007). The first part contains five questions focused on determining what ideas teachers hold regarding teaching as it relates to environmental and technological problems. In the original version of the

survey environmental threats and problems are used somewhat interchangeably. This arose through negotiation as Guisasola, Robinson, and Suza (2007), an internationally diverse group, grappled with semantic preferences. In the earlier research, some cultures preferred the use of the word threat as it was believed to extend the focus beyond those environmental problems that had already come to fruition to include threats that would become problems in the near future if not mitigated. Other cultures involved in the earlier work, did not originally sense the need for this distinction (M. Robinson, personal communication, August 17, 2009). Because of the validity work done in the original research where the instrument was created, a decision was made in this current research to maintain the original language included in the Guisasola, Robinson, and Suza (2007) survey.

The second part of the original questionnaire asks teachers to rank the significance of the following eight global environmental threats: Conflicts and Violence, Depletion of Natural Resources, Ecosystem Degradation, Environmental Pollution, Human Health and Disease, Land Use, Sustainable Development, World Hunger and Food Resources. A third part, created in collaboration with one of the original questionnaire authors (Robinson) for this particular research, was focused on the impact of religion on the teaching of environmental issues. This part of the questionnaire consisted of four questions ranging from what religion the teachers practiced to the extent to which these views influenced science teaching. The rationale for the inclusion of a subscale focused on religion is in connection with the significance and tradition this element has in each of these cultures. When the researchers considered the cultural background of each nation, it was noted that the religious affiliations were different in each country. Based on this distinctive nature of this issue, and knowing that at least in the Bolivian and Turkish communities religion has a historical tradition as a governmental entity, it was deemed important to gather data on the role this cultural aspect has on EE practices implemented in these nations. Furthermore, since environmental education addresses unifying concepts in science such as change (e.g., global warming) and cycles (e.g., El Niño effect) which are of great currency in today's science classroom instruction, it was also judged convenient to explore possible impacts of religious beliefs in the decisions being made at the curricular level, particularly in EE, in these countries.

Before the questionnaire was used in Bolivia and Turkey, it was translated from English to Spanish to gather the Bolivian teacher data and Turkish to gather the Turkish teacher data. A native Spanish speaking university faculty member (second author) with fluent English skills did the translation of the Spanish version, while a native Turkish speaking university faculty member (third author) with fluent English skills did the translation of the Turkish version.

Limitations of the Study

The limitations to this study included 1) the reliance on convenience sampling and 2) the lack of calculated reliability measures for the revised instrument used in this current research. While content validity was established for the original instrument as reported by Guisasola, Robinson, & Suza, (2007), no reliability measures were originally calculated for the instrument when the instrument was constructed or in this current research. But, while the limitations are present, it is believed that much could be still be gained in comparing these convenience samples using the instrument employed as long as the limitations were made transparent at the outset.

Analysis

Descriptive statistics were determined for the both the personal data and for the teachers' questionnaire responses informing each of the seven research questions. Coding was completed to quantify the open-ended questions so that all questionnaire data were either quantitative or trans-

formed into quantitative data that could be analyzed using chi-square and follow up post hoc tests (either Scheffe or Fisher's Exact) which were appropriate to determine whether comparison of responses from the three countries were statistically significant. More specifics of the strategies used for transforming open-ended responses are offered in the results section that follows.

Results and Discussion

The overarching goal of this study was to examine similarities and differences among teachers from three different nationalities in terms of their attitudes to environmental issues and their EE instructional practices. Five major concepts (knowledge, instructional practices, decision-making process, and cultural features) were embedded within the seven research questions. Overall, the employed instrument explored teachers' current knowledge on environmental global issues informing their classroom instruction (research question 1), their rational for the inclusion or not including technology-related problems in their EE instructional practices (research questions 2 and 3), the origin of instructional materials and resources they use in their science classrooms when addressing environmental issues (research question 4), the decision-making processes employed when teachers design their instruction (research questions 5 and 6), and the influence of religion in their EE instruction (research question 7). The research findings and discussion are presented for each research question in the section that follows.

Research Question 1: To what extent are science teachers familiar with technological and/or environmental problems discussed at the 2007 Bali-Indonesia United Nations Climate Change Conference?

The central theme of the Bali Conference was climate change as is evidenced in the name of the conference. Teacher responses to this open-ended question were coded as *Yes-Teacher was Familiar* or *No-Teacher was not Familiar* based on their responses. Teacher responses coded as *Yes-Teacher was Familiar* focused on climate change, global warming, and greenhouse gas pollution. Those teacher responses coded as *No-Teacher was not Familiar* focused on other environmental issues or did not offer a response to the question. Two researchers (first and fourth author) coded these responses separately before comparing their coding. Any inconsistencies in coding were discussed until agreement was reached before the data set was finalized. The descriptive statistics are found in Table 1.

Table 1. Descriptive statistics of responses to research question 1

Country	*Yes-Teacher was familiar*	*No-Teacher was not familiar*
U.S. Teachers (N = 54)	33 (61.1%)	21 (38.9%)
Bolivian Teachers (N = 63)	23 (36.5%)	40 (63.5%)
Turkish Teachers (N = 54)	16 (29.6%)	38 (70.4%)
Total Teachers (N=171)	72 (42.1%)	99 (57.9%)

In Table 1, overall the majority of teachers were not familiar with the technological and/or environmental problems discussed at the 2007 Bali-Indonesia United Nations Climate Change Conference. A chi-square test was conducted to compare three nations on teacher's knowledge about the problems discussed. The results indicated that there was a significant difference between the three countries, $\chi^2(2, n = 171) = 12.26, p > .002$. A Fishers' Exact post hoc test indicated that the U.S. was significantly different when compared to Bolivia and Turkey, while no differences found between Bolivia and Turkey.

These findings suggest that most teachers were not attuned to the focus of the Bali Conference. Indicating that, at least on an international level, the teachers in this study were not drawing on common sources of current concerns capable of informing environmental education, at least with respect to the conference. These findings also indicate that more U.S. teachers (61.1%) were able to identify the focus of the conference compared to Bolivia (36.5%) and Turkey (29.6%). With respect to the U.S. findings, these contradict those found by Guisasola, Robinson, and Suza (2007) when they asked U.S. teachers about the previous UN sponsored Johannesburg Earth Summit held in 2002 and found that 57% of the teachers they surveyed where not familiar with problems discussed at that summit.

One possible explanation for this change in the U.S. may be tied to the increased recognition of climate change concerns at least partially connected to Gore's (2006) widely circulated and publicized documentary *An Inconvenient Truth* and his subsequent recognition with a Nobel Prize for this work. Another possible explanation for this difference could be attributed to the attention that movements such as green citizenship (Grabrielson & Parady, 2009) and political debates on energy use, for instance, receive in this country. In the education arena, teachers from this nation are also well aware of efforts such as the *No Child Left Inside Act* which has rapidly gained currency in the education and political sector. Over 800 organizations nationwide are united in trying to get this act supported by the federal government. On the other hand, it could be said that educators from the other two nations may deal with different political and educational issues, which do not necessarily address pressing global environmental problems. It has been reported that "perceptions of environmental threats are based on citizens (teachers) personal experiences with the threats in the environment in which they live" (Guisasola, Robinson, & Suza, 2007, p. 1). These observations are supported by others in the field (Stern & Dietz, 1994) who have found that citizens' environment-oriented behaviors are linked to the value individuals assign to themselves, to others and to fauna and flora resources (Person's Value System). In correspondence with this view, Wesley-Shultz (2000) submits that environmental awareness takes place only when citizens view themselves as integral part of the environment. Recognizing that citizens (teachers) from different latitudes are confronted with different immediate realities would lead us to think that in this study the reactions presented by teachers to global issues of ecological relevance are informed mostly by their local and national socio-political concerns.

Research Question 2: What rationales are offered by science teachers for including or not including technological and/or environmental threats to the environment in science classroom instruction?

To answer Research Question 2, two researchers coded these responses similar to the process described for the coding of Research Question 1. The open-ended responses were first coded as rationales offered that were either *Supportive* or *Not Supportive* of the inclusion of technological and/or environmental threats to the environment in science classroom instruction. The coding was then further refined with the two groups as constant-comparison method of analysis (Merriam, 1998) was used to classify the rationales offered. The dominant emergent *Supportive* and *Not Supportive* rationales as well as their frequencies are included in Table 2.

Table 2. Dominant supportive and not supportive rationales for whether technological and/or environmental threats were included in science classrooms

Supportive/ Not Supportive	Rationale	Frequency			
		Total (N=171)	U.S. (N=54)	Bolivia (N=63)	Turkey (N=54)
Supportive	Supportive of student future roles as citizens	50	11	31	8
	Included in state and national science curriculum	20	8	0	12
	Student Awareness of Environmental Issues	28	8	7	13
	Other	25	8	10	7
Not Supportive	Conflicts with state and national curriculum	7	5	1	1
	Other	41	14	14	13

Overall, the teacher sampled most frequently articulated a rationale supportive of students' role as future citizens for including technological and/or environmental threats in science classrooms. State and National Curriculum Standards were cited as well as a belief in the importance of helping students become more aware of environmental issues were also found articulated by a significant number of the teachers surveyed. When looking at the rationales offered that were *Not Supportive*, the great majority of these were coded as *Other* as they were not found cohesive enough for the researchers coding the open-ended responses to warrant independent themes. Examples of these rationales included 1) *not enough time*, 2) *sometimes students do not have enough background* and 3) *contemporary issues are not aligned with students' level of development*. Finally, the belief that this inclusion would contradict the state or national curriculums in the given country was also a code found in the *Not Supportive* rationale. Overall, this final category was not a widely held view.

To determine whether there was a difference between the three countries with regards to the *Supportive* rationales articulated a chi-square test was completed. The chi-square results, revealed that there were significant differences in these rationales, $\chi^2(6, n = 171) = 27.77$, $p > .0001$. Scheffe post hoc tests revealed that science teachers in Bolivia and U.S. are more often considering students' roles as future citizens, while teachers in Turkey were more often found influenced by curriculum standards and students' global awareness. Interestingly, none of the teachers in Bolivia referenced the curriculum standards when considering why they think

inclusion of EE is important. A chi-square test was also conducted to determine whether there was a difference between the three countries with regards to the *Not Supportive* rationales articulated. This test revealed no statistical differences between the three countries with respect to the *Not Supportive* rationales identified.

The rationales offered by teachers regarding their decisions for the inclusion or not of technological and environmental threats in their EE instruction highlight a noble endeavor, supporting 'students' future role as citizens.' Although this goal is embedded in national and state reform education documents in the three countries, its selection seems to be more supported by humanistic tones than by the political underpinnings stirring changes in schools across the world. In a 'global climate' of education testing, restructuring, and accountability, one would expect to see a close alignment of teachers' instructional decisions to national curriculum standards. This reason was the third supportive rational cited by teachers, especially from the U.S. and Turkey. One explanation could be in the fact that EE is vaguely addressed in the national curriculum, and therefore it does not receive the figuration of the more prominent core science subject areas. It is interesting to note that Bolivian teachers however did not refer to the standards as an element informing their supportive rationale for the inclusion of technological and environmental threats in their EE instruction. This finding is concomitant with the national curriculum that is characterized as being in an emerging phase, and also by major problematic issues such as teacher training and the design and availability of instructional materials. Bolivian teachers based their instructional decisions on a set of general competencies their students must meet at certain grade levels. Standardized testing has not arrived yet to K-12 Bolivian classrooms. Therefore, it would be expected that Bolivian teachers do not see a set of national standards—that do not exist yet—as an important aspect in their daily instruction.

Research Question 3: To what extent do science teachers report including technological and/or environmental threats in science classroom instruction?

The results for Research Question 3 are found in Table 3. As can be seen, overall a large percentage (77.2%) of teachers from each country reported including technological and/or environmental problems in science classroom instruction. No significant differences were found between the three countries when a chi-square test was conducted.

While a large percentage of participants in this study from each country did report including technological and/or environmental problems in their science instruction, there was a sizable percentage that did not. If each teacher in this study worked with only 30 students, which is likely less than the number that they actually work with, approximately 1100 students would not have formal experiences with EE. One concern that that Environmental Educators have about EE being integrated into other science disciplines is that integrated may for some (perhaps up to ¼ of students as is seen in our study) lead to omission altogether. Although we agree that EE can be also offered during instructional time in other subjects (e.g., social studies, art) it is also noted that its instruction falls mainly in the science content area. Our claim about the number of students being left out from EE opportunities is based on the fact that, particularly in Bolivia and Turkey, teachers are regarded as 'specialists' in their subject. Therefore they are held responsible for managing all the instructional activities deriving from the national and state curriculum. EE instruction is therefore expected in science classes, by the teacher who is considered knowledgeable in that subject. There is also a structural aspect that contributes to this occurrence of this feature. Typically, there is a science teacher (sometimes only one) responsible for the biology classes for the middle school levels, one more for the chemistry classes and physics classes in the high school grade levels.

Table 3. Descriptive statistics of responses to research question 3

	Do or Do Not Teach About Environmental Problems	
Country	Do Not	Do
U.S. Teachers (N = 54)	12 (22.2%)	41 (77.8%)
Bolivian Teachers (N = 63)	14 (22.2%)	49 (77.8%)
Turkish Teachers (N = 54)	13 (24.1%)	40 (75.9.%)
Total Teachers (N=171)	39 (22.8%)	132 (77.2%)

The majority of the participating teachers from each country highlighted the use of technology and environmental issues as instructional tools in science classrooms. Nevertheless, there are still a substantial number of students represented in this study whose science learning lacks these crucial curricular elements. It has been noted that EE should be intended to assist people (students) in their understanding of local and global environmental issues, so that they achieve a level of literacy informing responsible decisions and allow them to take appropriate actions regarding personal and public issues (Liarakou, Gavrilakis, & Flouri, 2009). According to the teachers' responses to the question addressing the integration of technology and environmental issues in their science instruction, it could be suggested that there is still a student community—a conservative estimate of over a thousand students in this sample—around the globe who are lagging behind in terms of a comprehensive understanding of environmental concerns afflicting their communities and the planet.

Research Question 4: What are the main sources of information that teachers use for attaining information about environmental problems/threats?

To answer this research question, teachers indicated the main sources of information they use regarding science based environmental problems/threats to the biosphere that they discuss in their classes: the textbook, newspapers, the internet, blogs, YouTube, webcasts, and other. Table 4 depicts the cumulative findings as well as the findings for each individual country sampled.

As is reported in Table 4, the most used source of information that teachers reported using was the Internet. A majority of teachers also reported using newspapers and textbooks. Those sources that were not used as frequently were blogs, YouTube, & webcasts. The cross-national comparisons revealed the same general trends across all three countries with only a few exceptions. A significantly higher percentage of science teachers reported using blogs and YouTube in Bolivia, ($\chi 2$ =14.6, p=.001; $\chi 2$ =17.4, p=.000). Additionally, no teachers in Turkey reported using blogs, YouTube, or webcasts. While the percentage of teachers using these resources was relatively small in the U.S. and Bolivia, there were at least a few teachers that reported using them in these two countries.

The fact that most of the participating teachers indicated the use of technology and environmental problems in their science classroom instruction is a positive sign of the currency that these two instructional tools should have in science learning settings. Some reasons that could be offered to explain these high ratings are in connection with the massive use of the Internet in today's society. This view is corroborated with teachers' responses to research question 4 in which

Table 4. Descriptive statistics for research question 4

	Total %		U.S. %		Bolivia %		Turkey %	
Source	Yes	No	Yes	No	Yes	No	Yes	No
Textbook	60.0	40.0	52.8	47.2	52.4	47.6	75.9	24.1
Newspaper	64.1	35.9	73.6	26.4	57.1	42.9	63.0	37.0
Internet	73.4	26.6	79.2	20.8	54.0	46.0	90.6	9.4
Blogs	6.5	93.5	1.9	98.1	15.9	84.1	0.0	100.0
YouTube	8.9	91.1	3.8	96.2	20.6	79.4	0.0	100.0
Webcasts	7.1	92.9	11.5	88.5	9.5	90.5	0.0	100.0
Other	14.9	85.1	36.5	63.5	9.5	90.5	0.0	100.0

they identified the Internet as one of the main sources of information for their science classes, a second information source for U.S teachers, is the newspaper, which might be also accessible to them via the World Wide Web. The use of the newspaper in science classes was also identified as the first and third source of information in the Bolivian and Turkish groups respectively. Likewise, current education reforms such as the National Science Education Standards (NCR, 1996) and other movements such as Science, Technology and Society (STS) support, at least in the U.S., the inclusion of technological aspects related to the teaching and learning of science in K-12 classrooms. This, in addition to the 'research-based' standard that today's classroom instruction should aim for, may have had an added effect in the growing use of technology in the science education community around the world.

From question 4, it is clear that the use of textbooks in science classes has become less predominant. For two of the three groups of teachers (U.S and Bolivia), the textbook is the third information source behind the Internet and newspapers. In Turkey the design and authority of the national curricula is overseen by the government. Instructional materials must pass its test before being allowed to be used in school classrooms. This compulsory aspect in the Turkish education system may explain the fact that Turkish science teachers placed textbooks as their second source of information.

Research Question 5: What do teachers think is most important to teach in science classes?

Research Question 5 was answered by having teachers from each country rank the importance of each of the following potential EE objectives on a 1-10 scale with 1 being full disagreement and 10 being full agreement:

A. Science classes must teach students how scientists work so students can assess better the everyday technological and environmental problems/ threats they face.

B. Science classes must teach scientific concepts and theories thoroughly enough to enable students to pursue further studies of everyday technological and environmental problems and or threats.
C. Science classes must teach information that enables student to acquire the democratic values needed in the social environment in which they live.
D. Science classes must teach students the essential scientific and technological literacy needed by informed citizens in contemporary society.

The results of the teachers' rankings are found in Table 5. Based on the descriptive statistics, generally there was agreement regarding teachers' goals and objectives in science classrooms with respect to EE. When comparing the four, the one that was ranked highest overall was *Science classes must teach students the essential scientific and technological literacy needed by informed citizens in contemporary society*. This was also the case when looking at which goals and objectives the U.S. and Turkish teachers ranked highest. Bolivian teachers ranked *Science classes must teach information that enables student to acquire the democratic values needed in the social environment in which they live* as the goals and objectives that they thought was most important and deserved of the most important.

In terms of the content teachers from these countries consider important to address in their science classrooms, the results show an agreement between U.S. and Turkish science teachers. Both groups of teachers indicated that science classes should (i) address the essential features of scientific and technological literacy needed by citizens in contemporary society and, (ii) teach students how scientists work so students are able to assess the way in which technology and environmental concern affect the world. These features reflect two aspects—the nature of science and scientific literacy—commonly found in the current science education reform in these countries. Unlike their counterparts, Bolivian teachers shared a different reaction to this question about the content that should have prevalence in the science curriculum. For them, science classroom instruction should be centered on (i) the democratic values needed in their social environment, and (ii) a thorough teaching of the concepts and theories that would enable students to pursue further studies of technological and environmental problems.

Table 5. Descriptive statistics for research question 5

Environmental Problem/Threat	Total (Avg.)	U.S. (Avg.)	Bolivia (Avg.)	Turkey (Avg.)
A (How Scientists Work)	7.96	7.43	7.81	8.63
B (Thorough Concepts & Theories)	7.79	7.32	7.87	8.17
C (Foster Democratic Values)	7.47	6.25	**8.53**	7.65
D (Scientific & Technological Literacy Supportive of Informed Citizens)	**8.29**	**8.45**	7.77	**8.65**

Regarding the convergence in the responses offered by both American and Turkish teachers concerning the content to be addressed in science classes, there is an aspect that closely identifies the two education systems. A constructivist philosophy, which is part of the foundations of the school science curricula in these nations, might be taken into account as a rationale for this concurrence. This interrelation is informed by current higher education programs available to Turkish teachers to be pursued in the U.S. Therefore, it could be suggested that both of these countries' science education initiatives may contain some degree of resemblance in terms of the overarching goals set for their national and state science education standards. The response submitted by Bolivian teachers—science instruction should foster democratic values—could be understood in light of recent socio-political upheavals stemming from differences among ethnical groups in different regions of the country. Although this issue has been on the political agenda of Bolivia, even since the first years of its independence, the current circumstances involve national and international issues affecting all branches of society, including the education sector. In her book, The Citizen Factory, Luykx (1999) refers to the socio-cultural elements of the Bolivian society that, in her view, make it difficult to conceptualize a unifying Bolivian nationalism. She notes that:

Bolivia is not well consolidated as a nation, and many see this as a primary cause of its underdevelopment. Some of its most characteristic features are also its most formidable obstacles to "national unity": linguistic diversity, a conflictive past, the persistence of indigenous cultures, a strong working-class consciousness, sharp social inequalities, and marked regional differences. (p. 18). Therefore, it should not be surprising to observe that science teachers, as citizens of this country, see their field as a space for their students to gain the needed democratic competencies to face the political demands of their cotemporary society.

Research Question 6: What do science teachers perceive as the most significant problem or threat to the environment?

To answer this research question teachers from each country were asked to rank the following global environmental problems / threats according to how important they think they are and the priority they should have in public policy:

- *Conflicts and Violence* (regional inequalities in the world, cultural and religious differences, increased access to war technologies including chemical, biological and nuclear agents, terrorism, Mafia activities, trans national enterprises which escape democratic control, etc.)

- *Depletion of Natural Resources* (Water, Minerals and Land; water and energy conservation, efficiency and reuse, alternative energy, loss of watersheds, water distribution, deforestation, desertification, reclamation, soil erosion, urban development etc.)

- *Ecosystem Degradation* **(**loss of biological diversity**,** extinction of plants and animals, wildlife habitat loss, ecological services, affects on human health, etc.)

- *Environmental Pollution and its Consequences* (Air and Atmosphere Quality, vehicle and power plant emissions, acid rain, global climatic change; Water Pollution, ground water contamination, human and industrial waste disposal, Land Toxicity, waste dumps, toxic chemicals, effects on human health, etc.)

- *Human Health and Disease* (infectious and non-infectious disease, antibiotic resistance, stress, diet and nutrition, exercise, mental health, pollution, etc.)

- *Land Use* (The demographic explosion, a finite planet, population growth, resource degradation and depletion, carrying capacity, etc.)

- *Sustainable Development* (world economics and politics, loss of ecosystems and environmental degradation, corporate expansion, World Trade Organization, etc.)

- *World Hunger and Food Resources* (processed food, genetically engineered foods, corporate agriculture, cropland conservation, etc.) (Guisasola, Robinson, & Suza, 2007, p. 31)

Table 6 reveals the overall and individual country averages for these threats that the participants rated. As is evidenced by the consistently low average rankings that emerged for the Turkish Participants relative to their U.S. and Bolivian counterparts, Turkish teachers did not rank these environmental problems/threats in a manner consistent with participants from the other countries. While U.S. and Bolivian participants ranked these in a hierarchical fashion from 1-8, with 1 ranked as most important and 8 indicating less perceived importance, the Turkish teachers instead more often ranked multiple problems/threats equally, resulting in lower overall averages. Because of this difference in the Turkish rankings, no statistical comparisons for differences were made instead only descriptive comparisons were made.

As can be seen in Table 6, overall the four most important issues were 1) Environmental Pollution and its Consequences, 2) Depletion of Natural Resources, 3) Ecosystem Degradation, and 4) Human Health and Disease. When looking at the three countries separately, the U.S. and Bolivian teachers, while not ranking them in the exact same order, did rank these as the four most important environmental problems/threats. The Turkish teachers' rankings were consistent for Environmental Pollution and its Consequences and Ecosystem Degradation, ranking these as two of the most important four. But, instead of ranking Depletion of Natural Resources and Human Health and Disease in this group, they ranked Conflicts and Violence and World Hunger and Food Resources among the four most important.

Conversely, Sustainable development and Land Use were consistently ranked as the least important environmental threat/problems indicated that they were perceived as least deserved of priority in public policy. This was slightly different in Bolivia as these teachers ranked Land Use as slightly more important, with a ranking of 5 instead of 7 or 8. There was a variety in the response that participating teachers gave to the question that inquired about major issues threatening the environment. For instance, U.S. teachers see the depletion of natural resources and environmental pollution as the main threats to the environment. As for the Turkish teachers, they suggest issues of violence followed by ecosystem degradation as the major problems. In the case of the Bolivian teachers, the major problems impacting the quality of the environment are environmental pollution and its consequences and ecosystem degradation. Stern and Dietz (1994) propose the Person's Value System framework as a tool to understand people's pro-environmental behaviors. They contend that these behaviors depend on the value people assign to themselves, to others and to natural resources. Such is the case of the environmental pollution issue identified by Bolivian teachers as the problem that deserves more priority in public policy. It should be noted that the whole sample of Bolivian teachers participating in this study are from the country capitol. La Paz is a city located at about 12,000 feet above sea level with major pollution problems. For instance, a serious environmental concern for the city residents is the poor conditions of the river flowing through the metropolitan area. Both industrial and domestic waste water are emptied into the river. Furthermore, the solid wastes management, especially in the popular sectors of the city adds another concern that affect the well-being of over a million people in La Paz. It could be then suggested that the way in which citizens (teachers) appraise

environmental resources is in concomitance with the availability and quality of the natural resources in their community, and this is probably the case of the teachers from La Paz, Bolivia.

Table 6. Descriptive statistics for research question 6

Environmental Problem/Threat	Avg. Total (Rank)*	Avg. U.S. (Rank)*	Avg. Bolivia (Rank)*	Avg. Turkey (Rank)*
Conflicts and Violence	4.32 (6)	5.10 (6)	5.70 (8)	2.17 (1)
Depletion of Natural Resources	3.22 (2)	3.18 (1)	3.78 (3)	2.69 (5)
Ecosystem Degradation	3.42 (3)	4.42 (4)	3.65 (2)	2.19 (2)
Environmental Pollution and its Consequences	3.03 (1)	3.64 (2)	3.20 (1)	2.24 (3)
Human Health and Disease	3.71 (4)	3.68 (3)	4.60 (4)	2.85 (6)
Land Use	4.59 (7)	5.84 (8)	4.82 (5)	3.11 (7)
Sustainable Development	4.79 (8)	5.51 (7)	5.48 (7)	3.37 (8)
World Hunger and Food Resources	4.07 (5)	4.76 (5)	4.95 (6)	2.50 (4)

*Note. * Rank goes from 1-8 with 1 being most important and 8 being least important*

Research Question 7: What role does religion play in science teachers' decisions about teaching environmental issues in a science classroom?

This research question was answer through the analyses of participants' response to the four survey questions found in Figure 1. The comparative plot as well as descriptive statistics of participants' responses to question 1 is found in Figure 2.

Figure 2 reveals that overall religion was thought to influence the extent to which participants included environmental issues in their science instruction. A one-way ANOVA was conducted to compare science teachers from three different nations on regarding the extent religion influences your science instruction. Results indicated a significant overall effect, F (2, 165) = 11.54, $p < .0001$, meaning that there was a significant difference between the teachers from three countries. Results of follow-up tests indicated that means from the Bolivian and Turkish participants did not differ significantly from each other; however the U.S. teachers differed significantly from the teachers of the other two countries.

Descriptive statistics for participants' responses to the second question found in Figure 1 are found in Table 7. Few similarities are found in Table 7 with respect to the religions practiced by

1. Which of the following describe the role you think your religion plays in influencing the extent to which you include environmental issues in your science instruction?

1	2	3	4	5
Not Influential		Somewhat		Very Influential

2. What is your religion? (Please select one)
    a. Buddhist
    b. Catholic
    c. Confucianism
    d. Hindu
    e. Mormon
    f. Muslim
    g. Protestant
    h. no religion
    i. other

3. Which of the following describes the importance of religion in your life?

1	2	3	4	5
Not Important		Somewhat		Very Important

4. Which of the following responses best describes your view about the influence of religion on the teaching of the Theory of Evolution in Biology?

    a. I would teach the theory even if it conflicts with my religious beliefs
    b. I would NOT teacher the theory if it conflicts with my religious views
    c. Undecided

Figure 1. Religion and environmental education questions

the participant science teachers. Mormonism, Catholicism, and Muslimism were the three dominant religions found in the U.S., Bolivia, and Turkey respectively. Of these three, Turkey was most dominated by one single religion (Muslimism). It should be noted that the teachers from the U.S. sample are unique in comparison to most other U.S. states with Mormonism being the dominant religion. The comparative plot as well as descriptive statistics of participants' responses to question 3, *which of the following describes the importance of religion in your life?*, is found in Figure 3.

As can be seen in Figure 3 overall religion was found to be important in the lives of science teacher participants. A one-way ANOVA was conducted to compare science teachers from three different nations on regarding the extent religion influences your science instruction. Results indicated that there was no significant overall effect, $F(2, 165) = .012$, $p=.988$, meaning that there was not a significant difference between the teachers from three countries.

The final religion/environmental education question asked to answer Research Question 7 was, *Which of the following responses best describes your view about the influence of religion on the teaching of the Theory of Evolution in Biology?*. The possible responses participants were asked to select from in answering this question are found in Figure 1. For the purpose of analysis,

Table 7. Descriptive statistics for religion/environmental education question 2

Religion	U.S. (%)	Bolivia (%)	Turkey (%)
Buddhist	0.0	0.0	0.0
Catholic	5.9	76.2	0.0
Confucianism	0.0	0.0	0.0
Hindu	2.0	0.0	0.0
Mormon	62.7	1.6	0.0
Muslim	0.0	0.0	98.1
Protestant	13.7	7.9	0.0
No Religion	9.8	1.6	1.9
Other	5.9	12.7	0.0

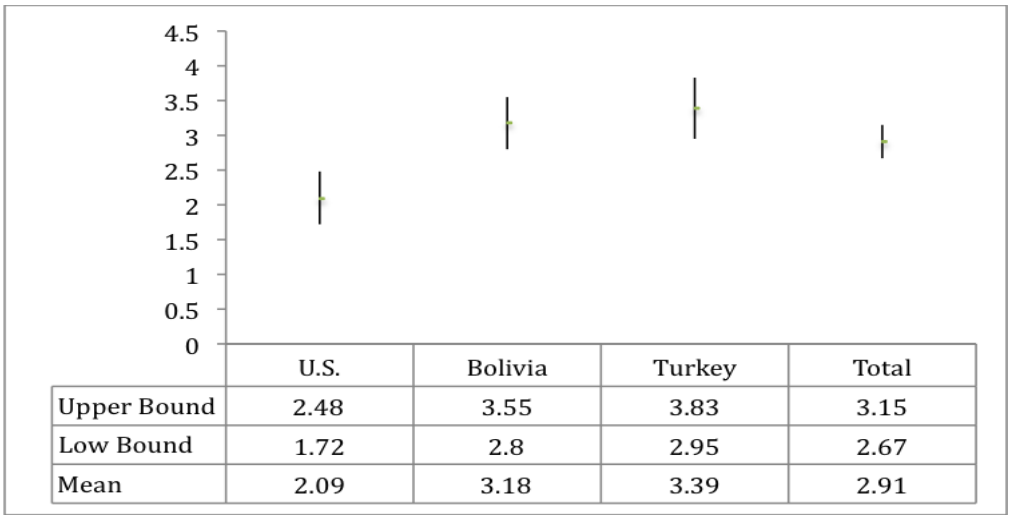
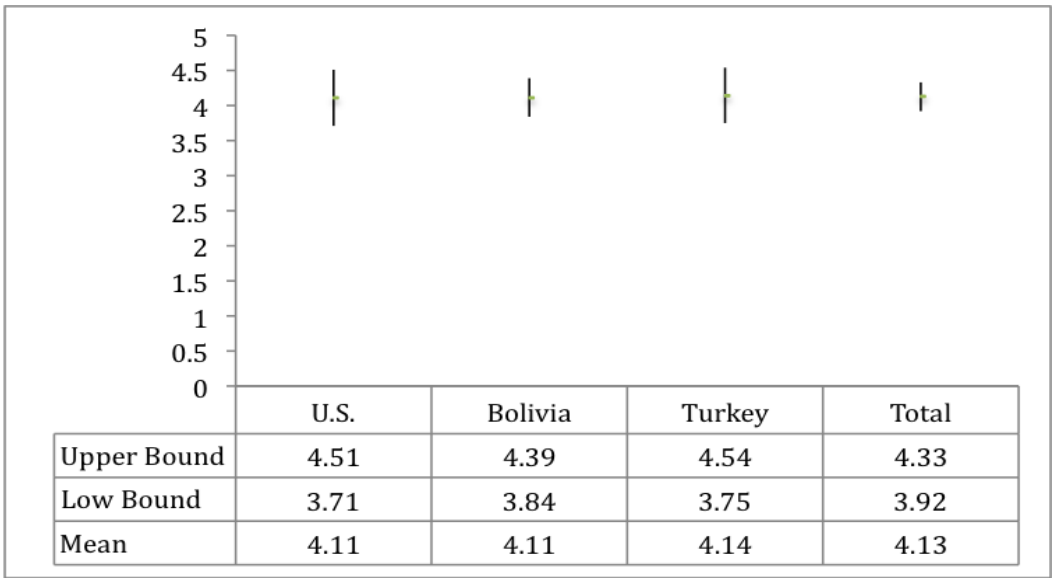


Figure 2. Religion/environmental education question 1 plot & descriptive statistics



	U.S.	Bolivia	Turkey	Total
Upper Bound	4.51	4.39	4.54	4.33
Low Bound	3.71	3.84	3.75	3.92
Mean	4.11	4.11	4.14	4.13

Figure 3. Religion/environmental education question 3 plot & descriptive statistics

a Chi-square test was conducted to compare the three countries responses. The Chi-square test indicated that there is a significant difference between these three countries, $\chi^2(2, n = 171) = 10.61$, $p = .002$. More exploratory analysis revealed no difference between the U.S. and Bolivian participants' responses. A difference was found when comparing Turkish participants' responses to both Bolivian and the U.S. participants.

A decision was made to combine the responses I would not teacher the theory if it conflicts with my religious views and undecided. This decision is not suggesting that the undecided would not teach the theory of evolution. It was a decision to look the comparison between those teachers that would and those that either would not or weren't sure if they would. The descriptive statistics for participants' responses are found in Table 8.

A Chi-square test was conducted to compare the three countries responses. The Chi-square test indicated that there is a significant difference between these three countries, $\chi^2(2, n = 171) = 10.61$, $p = .002$. More exploratory analysis revealed no difference between the U.S. and Bolivian participants' responses. A difference was found when comparing Turkish participants' responses

Table 8. Descriptive statistics for religion/environmental education question 4

Influence	Total (%)	U.S. (%)	Bolivia (Avg.)	Turkey (Avg.)
I would teach the theory even if it conflicts with my religious beliefs	81.8	92.3	84.7	68.5
I would NOT teacher the theory if it conflicts with my religious views & Undecided	18.2	7.7	15.3	31.5

to both Bolivian and the U.S. participants.

The last four items in the survey addressed teachers' views on the importance and role that religion has in their science teaching. It is important to note that each of the three groups of teachers have a different religious affiliation (Mormon, Catholic, and Muslim). Although the three groups of teachers agreed on the importance of religion in their lives, Bolivian and Turkish teachers indicated that religion is a deciding factor in the prevalence they give to environmental issues in their science curriculum. U.S. teachers however did not share the same perspective. It could be assumed that because of the division between state and religion in the U.S. teachers in general, do not attend to their religious beliefs to directly inform their instruction in the science classroom. Conversely, both Bolivian and Turkish teachers rely heavily on religion as a guiding force in their instruction. In each of these countries Catholicism and Muslim are the most common religions. This is a major factor on which these nations were founded. Authority figures in these societies, especially in the past, were also religious leaders with power over the decisions affecting the entire community, including education, which is a main element in the structure of the society. Despite the relevance that religion has in their personal and professional lives, Bolivian and Turkish teachers, like their U.S. counterparts concur in the teaching of evolution in their science classes.

Conclusions and Implications

The role that EE has in the school curriculum is of paramount interest for the achievement of goals put forth by the NAAEE, which are in agreement with EE initiatives proposed by international environmental organizations. Three salient aspects of EE are at the core of science education practices aimed at empowering future citizens in terms of their participation in public debates and decision-making around environmental issues. School science is called to provide students with opportunities to build awareness about the impact of socio-economic and political practices on the environment, foster the necessary skills, knowledge and values for the protection of the environment, and promote action-oriented behaviors towards conservancy and sustainability. Results from this study lead us to see that school curricula, either nationalized or decentralized, are only one element of the puzzle. Local needs, demands, and interests are also informative of the type of EE leaders in each community are responsible for providing to their student population. Kaplan (2000) urges community leaders (teachers) to take into account 'local variants' such as culture, needs and motivation in the community, and participation of community members in education efforts oriented toward the achievement of the goals abovementioned.

Currently, issues such as global warming are part of the instruction in science classrooms around the world, however at varying degrees of complexity (Groves & Pugh, 1999). The key EE outcome should be framed on the way in which each school community elucidates the controversy—including misconceptions—about environmental problems and "come to a conscious decision and take action towards a crucial theme." (Liarakou, Gavrilakis, & Flouri, 2009, p. 18). This goal requires a concerted effort on the part of school systems willing to risk their power on behalf of EE opportunities for their students as a mechanism to sustain meaningful science education practices that may support a successful adult life of their today's students and tomorrow's community leaders. Counting on the return of EE to the science classrooms, teacher education programs will also have a major contribution to make to the process. Knowledgeable teachers who are positively predisposed to take on this task, and convinced of their roles, need to have available proper EE training during their teacher education programs. Due to the current impact that environmental issues have across the globe, it is now necessary, more than ever the implementation of EE studies that may become informative of instructional practices as mandated by nation-

al of local government agencies in each country. This line of investigation is also welcome in times of debate on education reform and international assessment that is assumed to be an indicator of education quality worldwide.

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Üç uluslararası öğretim toplumunda çevre eğitimi ile ilgili fen öğretmenlerin tutumlarının ve bilgilerinin araştırılması

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Bu çalışmada üç farklı ülkeden (54 ABD, 63 Bolivya ve 54 Türk) yüz yetmiş bir 7-12 sınıf fen öğretmeninin çevre eğitimine ve öğretimsel uygulamalara ilişkin tutumlarındaki benzerlikler ve farklılıklar araştırılmıştır. Öğretmenlerin bilgilerinin, öğretim uygulamalarının, karar verme süreçlerinin ve kültürel özelliklerinin çevre eğitimine yönelik tutumlarını ve alışkanlıklarını nasıl etkilediğini araştırmak amacı ile bir ölçek kullanılmıştır. İspanyolca ve Türkçeye, sonra yeniden İngilizceye tercüme edilen ölçek, kişisel bilgileri yoklayan demografik sorular ve üç kısımdan oluşan bir anket içermektedir. Analiz sonuçlarına göre, üç ülke arasında ifade edilen şu hususlara ilişkin anlamlı farklılıklar bulunmuştur: 1) öğretmenlerin küresel çevre konularına ilişkin bilgileri, 2) öğretmenlerin çevre eğitimini fen öğretimi içerisinde bulundurma mantığı ve 3) öğretmenlerin hayatında dinin önemine ilişkin anlamlı bir farklılık yokken öğretmenlerin öğretime ilişkin kararlarında dinin etkisi ile ilgili raporlarında anlamlı farklık bulunması. İlaveten, öğretmenlerin çevre eğitimini sınıfta kullanmalarını destekleyen kaynaklara ilişkin de farklılıklar vardı. Fen sınıfındaki öğretimi uygulamalarında, her ülkenin rapor ettiği çevresel ve teknolojik problemlere ilişkin olarak anlamlı bir farklılık yoktu. Sonuç olarak, genel anlamda öğretmenlerin fen sınıfında çevre eğitimine ve çok önemli küresel çevre sorunları/tehditlerine yönelik hedef ve amaçları arasında bir uyumun olduğu gözükmektedir.

Anahtar Kelimeler: Çevre eğitimi, hizmet içi öğretmenler, küresel çevre konuları, uluslararası fen eğitimi, ekosistem