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# Environmental Education as a Catalyst for Changing Students' Environmental Attitudes: A Survey of Ten Universities in the Tokyo Bay and San Francisco Bay Areas

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# ENVIRONMENTAL EDUCATION AS A CATALYST FOR CHANGING STUDENTS' ENVIRONMENTAL ATTITUDES: A SURVEY OF TEN UNIVERSITIES IN THE TOKYO BAY AND SAN FRANCISCO BAY AREAS

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ABSTRACT

ENVIRONMENTAL EDUCATION AS A CATALYST FOR CHANGING STUDENTS' ENVIRONMENTAL ATTITUDES: A SURVEY OF TEN UNIVERSITIES IN THE TOKYO BAY AND SAN FRANCISCO BAY AREAS

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Environmental education has been internationally recognized as a key tool to counter increasing threats to the environment. Previous studies have found that environmental values and beliefs are the fundamental factors that shape various pro-environmental behaviors. This study aimed to increase our understanding of how environmental education during childhood and university periods influence students' sense of connectedness to nature and ecological worldview. Two measures, the Connectedness to Nature Scale (CNS) and the New Ecological Paradigm (NEP) scale, were used for this purpose. A total of 1,266 students in 10 universities in the San Francisco Bay Area and Tokyo Bay Area participated in the survey. Survey results revealed that university education was more strongly correlated with the CNS and the NEP than childhood education and that experience-based learning was more influential than knowledge-based learning. Demographic variables such as gender, religion, and country, significantly influenced the CNS and the NEP; however, their influence was relatively small compared to environmental education. Teachers and program managers should include more experience-based learning approaches to environmental education and should emphasize the importance of lifelong learning process of environmental education.

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# INTRODUCTION

## Motivation and Scope

Human activities have had great impacts on the natural environment worldwide. The serious consequences of environmental issues such as habitat degradation, loss of biodiversity, pollution, and climate change, can be seen in every corner of the Earth. Although the natural environment has been altered and degraded throughout human history, these problems have become increasingly visible beginning in the late 1960s. Various solutions, including political, economic, and technological inventions, have been proposed to counter this increasing ecological threat. These solutions range from local grassroots environmental activism to international regulations and treaties; however, the effects of our cumulative efforts are still insufficient. Environmental education is one of the many solutions proposed.

The goal of environmental education is "to change individual behavior toward the environment by producing environmentally literate and responsible citizens" (Farmer, Knapp, and Benton 2007, 33). According to the Tbilisi Declaration, which was established at the Intergovernmental Conference on Environmental Education in 1977, there are five fundamental objectives of environmental education: to develop people's 1) awareness, 2) knowledge, 3) attitudes, 4) skills, and 5) participation related to environmental issues (UNESCO 1978). The declaration also stated that environmental education should be a lifelong learning process that targets all ages and groups in the society; therefore, it inherently involves both formal and informal education (UNESCO 1978).

Since the 1990s, environmental education has been internationally recognized as a key tool to creating a sustainable society and has been implemented into formal school systems including higher education (Teksoz, Sahin, and Tekkaya-Oztekin 2012). This year (2014) marks the final year of the U.N. Decade of Education for Sustainable Development (UNESCO 2005). In spite of the increasing international recognition, environmental education has not been a priority for many schools and educators at regional levels. For example, only 12% of universities and colleges require environment-related coursework in the United States (Hammond and Herron 2012). Implementation of environmental education at the K-12 level is uneven because some schools cannot afford to offer such opportunities due to a lack of resources (Feinstein and Carlton 2013). The lack of opportunities for environmental education in formal school systems has resulted in little improvement of public environmental awareness throughout the last several decades (Evans and Birchenough 2001).

There is a need for improving environmental education at both the K-12 and university-level institutions (Kaplowitz and Levine 2005). Furthermore, there is a need for developing environmental education outside formal school systems, because individuals' positive attitudes toward the environment are not only developed by school curricula but also by various life experiences (Chawla 1999). The ultimate goal of this study was to support the further improvement and implementation of environmental education both inside and outside of formal school systems by providing empirical data based on students' surveys.

## Background

Although environmental education has broad objectives, its end goal is to motivate each individual to act for the resolution of environmental issues. Therefore, "education *for* the environment" (UNESCO 1996, 17), the step where learners develop their sense of responsibility and take a concrete action for environmental improvement (i.e., pro-environmental behavior), is the final stage of environmental education. Consequently, many researchers have explored what makes people act pro-environmental and have provided some important theoretical frameworks (Dutcher et al. 2007; Kollmuss and Agyeman 2002).

One well-documented behavioral theory is the value-belief-norm theory proposed by Stern and his colleagues in 1999, based on the Schwartz's norm activation theory (1977) and value orientation systems (1994). According to the theory, personal values are the fundamental factors that shape various types of actions. In an environmental context, the degree to which a person values nature and the life of all living beings will affect how he views general human-nature relationship, and more specifically, how he views particular environmental problems (i.e., what is happening and what to do to solve the issue). This awareness of consequences leads to a personal norm, or moral obligation, that eventually activates pro-environmental behavior (Stern et al. 1999).

The value-belief-norm theory also emphasizes the importance of the social and cultural contexts in which people live. Stern, Dietz, and Guagnano (1995) argued that childhood experiences are shaped by social structure. In other words, children have different experiences depending on the place they live, their culture, ethnicity, gender,

socioeconomic status and so on. The influence of these social contexts can be strong and long-term, because people's values are generally developed early in life and remain for a lifetime. Furthermore, society may provide opportunities or constraints in response to particular actions, affecting individuals' behavior. For example, it is much easier to drive less in Japan than in the U.S. because of the geographical conditions and the transportation systems. The strong influence of social and cultural contexts on the formation of environmental values, beliefs, and behavior has also been discussed in other studies (Corraliza and Berenguer 2000; Oreg and Katz-Gerro 2006). Figure 1 shows the schematic model of value-belief-norm theory.

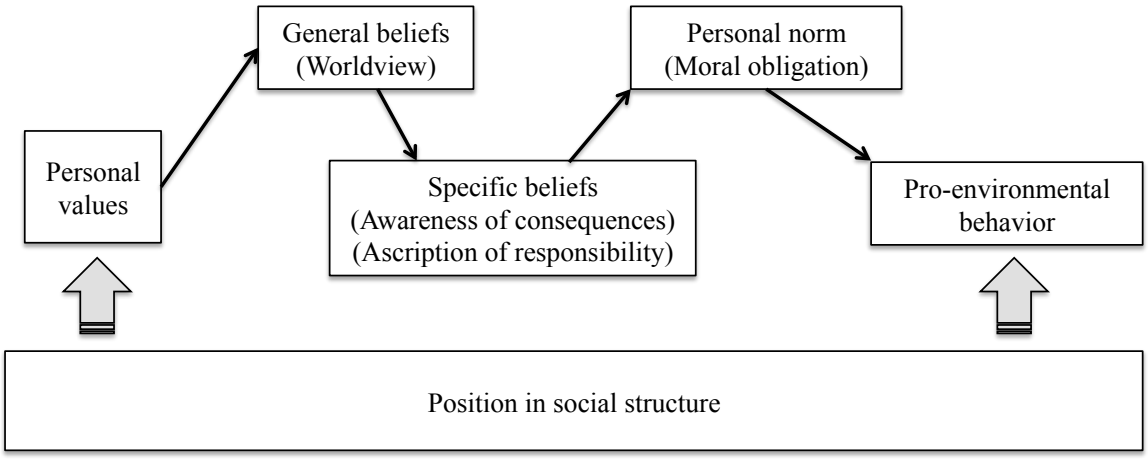


Figure 1. Schematic model of value-belief-norm theory proposed by Stern et al. in 1995. This model shows that personal values are the fundamental factors of pro-environmental behavior. The importance of position in social structure is also indicated. Source: Figure adapted from Stern, Dietz, and Guagnano (1995, 727).

Although environmental values (and beliefs) are strongly influenced by social contexts, they can be developed by educational programs as well. A conventional educational approach, which focuses on the acquisition of knowledge, can be classified as

"education *about* the environment," in which leaners study environmental problems and their relationship with human society (UNESCO 1996, 16). This type of approach to environmental education has been the dominant style of curriculum in schools for the last couple of decades and is based on the assumption that increased environmental knowledge automatically resulted in more positive environmental attitudes and thereby behavior. However, many studies have shown that the relationship was not that simple and that environmental knowledge could explain only a small variation in pro-environmental behavior (Kollmuss and Agyeman 2002).

Recently, increasing attention has been paid to another type of educational approach: place-based environmental education. Place-based environmental education provides learners with direct observations and experiences in nature in a particular locale (Woodhouse and Knapp 2000). This type of approach can be classified as "education *in* the environment," which views the environment itself as a resource for learning (UNESCO 1996, 16). Recent studies have shown that such activities strengthen people's emotional attachment to the place where they are learning (Stern, Powell, and Ardoin 2008; Takano, Higgins, and McLaughlin 2009), resulting in a higher value ascription on the community and its environment. Other researchers have also suggested that experiences in nature, especially during childhood, significantly affect people's attitudes toward nature (Chawla 1999; Ewert, Place, and Sibthorp 2005; Farmer, Knapp, and Benton 2007; Sward 1999).

Various environmental behavioral theories have been proposed to date, suggesting that there are many factors that shape and influence pro-environmental

behavior (Kollmuss and Agyeman 2002). There is no doubt, however, that values and beliefs are the underlying forces that determine our everyday actions. Even if they are not directly linked to a particular behavior, their influence is not negligible from a broader perspective of human life. This study aimed to increase our understanding of how those two different approaches to environmental education, knowledge-based and experience-based, influence students' environmental values and beliefs. This study also addressed the relative importance of social and cultural contexts on the development of students' environmental values and beliefs by conducting a cross-national survey in the U.S. and Japan.

## Literature Review

### Sense of Connectivity with Nature as a Precedent Factor of Biospheric Value

Value-belief-norm theory suggests that personal values are the fundamental forces that shape an individual's environmental behavior. Along with the theory, Stern and his colleagues (1993) argued that there are three types of value orientations with regard to the environment. They are egoistic, social-altruistic, and biospheric value orientations, which represent the concerns for oneself, others, and the biosphere, respectively. People with a strong egoistic value orientation are concerned with the environmental problems only when the problems impact their personal lives. Contrary, people with a strong social-altruistic value orientation care about the environment for people in distant places; and people with a strong biospheric value orientation are concerned about the environment for the sake of all living beings or the whole ecosystem. For those with strong biospheric value orientations, other organisms such as trees, birds, flowers, and insects are intrinsically valuable. These three values are inclusive rather than exclusive, indicating that a person's environmental behavior is influenced by the combination of all three values.

Biospheric value can lead to a broader motivation for pro-environmental behavior than socio-altruistic or egoistic values because it expands people's concerns to the entire biosphere (Dutcher et al., 2007; Schultz, 2001; Stern, Dietz, & Kalof, 1993). Schultz (2001) argued that the level of endorsement of this biospheric value is influenced by the degree to which people feel interconnected with nature. His study showed that when people viewed themselves as interdependent with all organisms, they expressed strong

biospheric concerns. In another study, he concluded "any activity that reduces an individual's perceived separation between self and nature will lead to an increase in that individual's biospheric concern" (Schultz 2000, 403). These results suggest that in order to develop biospheric value orientation, people first need to develop their sense of connectivity with nature.

The famous ecologist, Aldo Leopold, emphasized the importance of humans' connection with nature. His land ethic proposed that the individual is a member of a community that includes "soils, waters, plants, and animals, or collectively: the land" (1949, 204). Having a strong sense of connectivity with nature means viewing nature as a part of the community to which one belongs. This involves a sense of belonging and emotional affinity toward nature (Dutcher et al., 2007). A survey conducted by Kals, Schumacher, and Montada (1999) revealed that emotional affinity toward nature was a significant predictor of pro-environmental behavior and that the affinity came from the past and present experiences in nature.

As previously mentioned, place-based environmental education has the power to develop students' emotional attachment to places, in other words, their sense of connectivity. A Japanese educator in the early 20th century, Tsunesaburo Makiguchi (1971), declared that direct contact with the natural environment in their homeland enables children to develop a sense of appreciation for life and the planet. In his theory, it is important for children to first develop their sense of connectivity with their immediate environment because it helps them to expand their love and sense of interconnectedness at larger scales. Some case studies have revealed that place-based

education helped children deepen their connection with the land and the local communities (Gallagher et al. 2000; Takano, Higgins, and McLaughlin 2009).

Researchers have developed several survey instruments in order to measure a respondent's sense of connectivity with nature. These include the Inclusion of Nature in the Self Scale (Schultz 2001), the Implicit Association Test (Schultz et al. 2004), the Connection with Nature Index (Stern, Powell, and Ardoin 2008), the Nature Relatedness Scale (Nisbet, Zelenski, and Murphy 2009) and the Connectedness to Nature Scale (Mayer and Frantz 2004). The first three measures include diagrams and computer-based tests, whereas the last two measures include statements-based tests. In this study, the Connectedness to Nature Scale (CNS) was used for measuring students' sense of connectivity with nature.

The CNS was "designed to tap an individual's affective, experiential connection to nature" (Mayer and Frantz 2004, 504). The scale is comprised of 14 items that ask respondents how much they generally feel connected to the natural environment. Mayer and Frantz (2004) conducted five small-scale studies that investigated the effectiveness of CNS as a measure of sense of connectedness to nature. They found that the CNS was positively correlated with the respondents' biospheric value orientation, life style, and their environmental behavior. The correlations between these variables were stronger compared to other scales used in previous studies such as the Inclusion of Nature in the Self Scale (Schultz 2001).

Some critics have suggested that the CNS does not measure an "emotional" connection to nature. Perrin and Benassi (2009) argued that the CNS was a measure of

cognitive beliefs about individuals' relationship with nature, rather than emotional affinity toward it. Their content analysis revealed that many of the items involved non-affective content (such as "I think…") and that even the items using the word "feel," the respondents showed a more cognitive-based reaction to the items. Despite their criticism, Perrin and Benassi agreed that the CNS involved a dimension of connectivity with nature. In this study, the CNS was used as a measure of students' sense of connectivity with nature, which also worked as an indicator of their biospheric values.

**New Ecological Paradigm as a Measure of General Environmental Beliefs**

General beliefs about the environment are the second fundamental factors for shaping pro-environmental behavior according to the value-belief-norm theory. The New Ecological Paradigm scale (NEP; New Environmental Paradigm scale as the original name; Dunlap et al. 2000) is the most widely used measure to investigate the respondents' general environmental beliefs. The original NEP scale was developed by Dunlap and Van Liere (1978) more than 35 years ago. At that time, they perceived a fundamental shift of social paradigms among the U.S. public. The dominant social paradigm around the time argued that technological advancement and economical growth could ultimately solve any social problems. The serious consequences of environmental problems that occurred during the 1970s, however, made people rethink their perception about the development. More people recognized that there was a limit to growth and that human activities could significantly damage nature. This new perception of the human-nature relationship was named "New Environmental Paradigm."

The original version of the NEP scale consisted of 12 Likert-type questions. In 2000, Dunlap et al. developed a new version of the NEP scale by adding several new items and rewording some outdated vocabulary. The revised NEP scale was composed of 15 Likert-type questions that tap "primitive beliefs" about the natural systems and its relationship with the human society. Unlike the CNS, the NEP items "measure beliefs about humans in the aggregate, not the individual's personal relationship to nature" (Mayer and Frantz 2008, 504). The 15 items were developed based on five sets of ecological ideas: balance of nature, limits to development, anti-exemptionalism of humans from nature, anti-anthropocentrism, and the possibility of an ecological catastrophe. In general, a person who scores higher in the NEP scale holds a more ecological worldview.

Over the last three decades, the NEP has been used in various environmental studies. Those studies revealed that a higher NEP score was positively correlated with the intended and observed pro-environmental behavior (Olli, Grendstad and Wollebaek 2001), although some studies found only a weak correlation (Scott and Willits 1994). Higher NEP scores have also been correlated with environmental knowledge (Arcury, Johnson, and Scollay 1986) and outdoor experiences (Ewert, Place, and Sibthorp 2005), which are the two basic approaches to environmental education being focused on in this study. A strong correlation between the NEP and the CNS has also been reported (Mayer and Frantz 2004). Mayer and Frantz showed that the CNS was more strongly correlated with the respondents' lifestyles (i.e., frequency of interactions with the natural environment) and pro-environmental behavior than the NEP, and very surprisingly, the

NEP was more strongly correlated with the biospheric values than the CNS; however, this result was based on small samples and may not be generalized.

Hawcroft and Milfont (2010) conducted a meta-analysis of 69 studies that used the NEP for measuring respondents' environmental beliefs. The 69 studies were conducted in 36 countries although a majority of them were conducted in North America, especially in the U.S. This suggests that although most of the studies so far have been conducted in the U.S., the NEP scale has the potential to be used internationally. For example, Vikan et al. (2007) conducted a cross-national survey using one Norwegian sample (from a developed area) and two Brazilian samples (from both developed and less developed areas). In their study, Brazilians as a unit scored higher in the NEP than Norwegians, suggesting that cultural difference was more influential than the difference in technological development with respect to environmental beliefs. This result indicates that environmental beliefs can be strongly influenced by the social context as proposed by value-belief-norm theory.

**Influence of Social Contexts: Ethnicity, Nationality, Religion, and Gender**

One of the main themes that environmental psychologists and sociologists have investigated is how "ethnicity" or "nationality" affects environmental values and beliefs. Lynch (1993) argued that Latin Americans in the U.S. view a human-nature relationship very differently from Anglo Americans. Latin Americans hold a holistic view of nature in which humans are an integral part of nature, whereas Anglo Americans tend to believe that people are separated from nature. Furthermore, Altman and Chemers (1980)

suggested that Asian, African, and Native Americans also hold such a harmonistic view of the human-nature relationship.

The dominated worldview in the Western culture (i.e., separation and distinction of humans from nature and other organisms) might partially originate from Judeo-Christian beliefs (Schultz, Zelenzny, and Dalrymple 2000). Judeo-Christian beliefs and traditions are one of the dominant cultures of the U.S., although various ethnic groups have added cultural diversity to the country. In general, Americans have believed that humans are exempt from the law of nature. On the other hand, Japanese and many other East Asian culture is based on Taoism and Buddhism, which emphasize the interconnectedness of all living beings and intrinsic value of each life. Therefore, an international comparison of environmental values between Western and Asian countries revealed that environmental worldviews contradicted traditional values in Western countries, whereas they did not conflict with traditional values in Asian countries (Aoyagi-Usui, Vinken, and Kuribayashi 2003). A comparison of environmental values and beliefs between Japanese and the U.S. samples has offered similar results (Pierce et al. 1987). He concluded that the concept of a "new" environmental paradigm was not totally new to Japanese people.

Interestingly, some studies have shown that ethnic variation in environmental values and beliefs contradicted to the expectation based on traditional culture. Despite the holistic natural view held by non-Anglo Americans, empirical data showed that Anglo Americans often scored higher in the NEP, and showed more pro-environmental behavior than Asian, Latin, and African Americans (Johnson, Bowker, and Cordell 2004).

Collectivism in Asian culture and individualism in Western culture support the idea that Asian ethnicities may hold more altruistic (and maybe more biospheric) values and that Western ethnicities may hold more egoistic values. However, a survey of Asian New Zealanders and European New Zealanders revealed an opposite result (Milfont, Duckitt, and Cameron 2006). Indeed, the influence of cultural backgrounds such as ethnicity, nationality, and religion on environmental values and beliefs are not well understood.

Another main theme that has been investigated by environmental sociologists and psychologists is how "gender" affects environmental values and beliefs. Many philosophers as well as activists believe that women are more likely to protect the environment and tend to create a harmonious relationship with nature. Ecofeminism is a representative of such an idea. The ecofeminism movement emerged during the 1970s, as a protest against male dominating society (Merchant 2005). It argues that male-dominant social hierarchy, technology, science, and capitalism have resulted in humans' domination in nature. The unique characteristics of females such as reproduction of life, and caring and nurturing of next generations can allow females feel more concerned about the health of biosphere.

A survey conducted by Tikka, Kuitunen, and Tynys (2000) found an interesting pattern in gender difference. They investigated university students' environmental attitudes, knowledge, and environment-related activity-participation using 202 male and 262 female samples in Finland. They found that male students had higher environmental knowledge but showed more negative attitudes toward nature. Men and women engaged in environment-related activities to a similar extent, but were interested in different types

of environmental activities. Other studies also found that women were more active in private environmental activities such as recycling, whereas men were more active in public environmental activities such as protest (McStay and Dunlap 1983). These results suggest that women have more emotional and personal reactions toward environmental problems than men. Another study revealed that females were more supportive of biospheric values (Larson, Whiting, and Green 2011). Because of the strong positive correlations between biospheric value and the CNS and the NEP (Mayer and Frantz 2004), women would feel stronger connections with nature and would have more ecological worldviews than men.

**Childhood and University Experiences: Which Is More Influential?**

Environmental education targets people of all ages, but significant attention has been paid to childhood. Many environmental education studies have suggested that positive attitudes toward nature are acquired during childhood and that such attitudes are often carried throughout life. One such evidence is offered by a "significant life experience" study of environmental professionals. Chawla (1999) conducted open-ended interviews with a total of 56 environmentalists in Kentucky and Norway. He asked the respondents what kind of events influenced their environmental sensitivity (i.e., awareness of and concerns about the environmental problems and commitment to work toward the resolution of the problems) throughout their lives. The majority of the respondents mentioned that early-life outdoor experiences was one of the most significant factors that shaped their environmental sensitivity. Other interview- and questionnaire-

based studies have also found a similar pattern (Corcoran 1999; Sward 1999; Wells and Lekies 2006).

Chawla's study (1999) has provided another interesting insight. According to his research, the factors that influenced the environmental sensitivity of respondents changed depending on their life-period. For example, "outdoor experience" was the most important factor during childhood, but it changed into "education" and "friends" during university period and "participation in environmental organizations" during adulthood. This result indicates that environmental values and beliefs could be developed not only during childhood but also during youth and adulthood by various factors.

Several studies have been conducted that investigated the effects of environmental education at the university level. Those studies have revealed that environment-related courses taught in universities have positive impacts on students' environmental knowledge (Hammond and Herron 2012), values (McMillan, Wight, and Beazley 2004), skills, and attitudes (Kobori 2009). One problem with university education, however, is that students only focus on their field of study. As a result, most students, with the exception of environmental-related majors, may not have the opportunity to take environmental-related courses. This may result in more positive environmental attitudes shown by environmental-related major students, as found in a previous study (Tikka, Kuitunen, and Tynys 2000). However, it is not well known whether such positive attitudes toward nature have already developed before entering university (and that's why they chose environmental-related majors) or being fostered through university

experiences. There is a need to investigate the relative influence of childhood- and university-learning experiences on students' environmental values and beliefs.

**Environmental Education in the U.S. and Japan and the Similarities and Differences between the San Francisco Bay Area and Tokyo Bay Area**

The United States may be one of the most advanced counties in terms of environmental education. Under the National Environmental Education Act in 1990, the U.S. Environmental Protection Agency (EPA) has been taking initiatives to expand and strengthen environmental education across the country (Potter 2010). Since the 1990s, the EPA has spent millions of dollars to support environmental education, providing various training programs and developing national standards of environmental education. Thanks to these efforts, environmental education has been increasingly implemented into both formal and informal settings. However, despite public support for environmental education, especially in formal school systems, its implementation is slow and uneven depending on schools (Fien, Yencken, and Sykes 2002).

Environmental education in Japan has been promoted by the Ministry of Education, Culture, Sports, Science and Technology. Traditionally, environment-related knowledge was taught only under other related subjects such as geography and science. Since the 1960s, new courses have been introduced into school curricula, including "pollution and health" in 1969, "mankind and the environment" in 1978, and "life environment studies" in 1989 (Fien, Yencken, and Sykes 2002). In 2002, environmental education was integrated into the new school curricula, as a subject named Integrated

Studies or Comprehensive Studies. In this course, students are encouraged to learn local natural areas and environmental problems through solution-based learning (Hirayama 2003). The opportunities of environmental education outside of schools are fewer than in the U.S.

The San Francisco Bay Area (SFB) and Tokyo Bay Area (TB) are one of the most populated regions in Japan and the U.S., respectively. They are located at similar latitudes across the Pacific Ocean, where the SFB is slightly more northern compared to the TB (Figure 2a). Both regions encompass large urban areas and some suburban and rural areas. The estuaries are important for sustaining the urban development and providing recreational and ecosystem services for people and wildlife species in the regions. Furthermore, both regions are characterized by high income and educational levels.

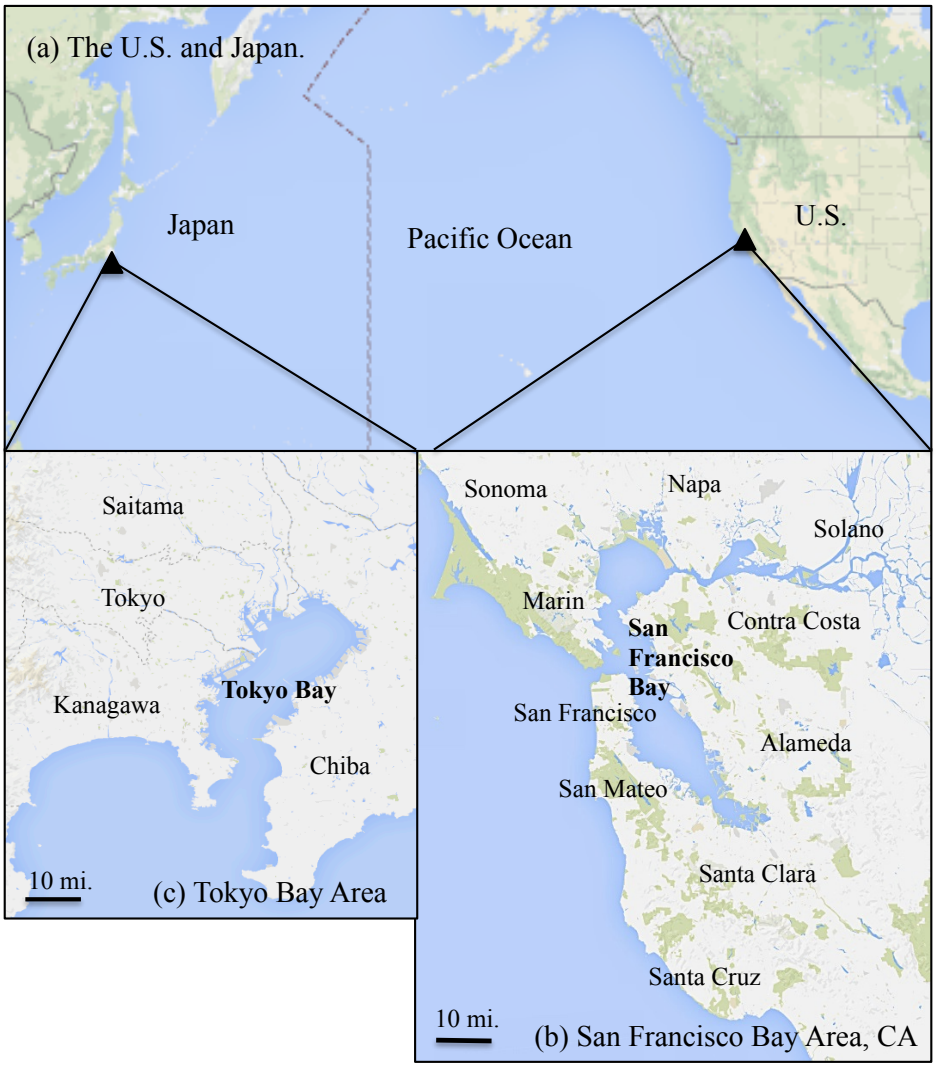


Figure 2. Maps of the San Francisco Bay Area and the Tokyo Bay Area and their respective geographical locations across the Pacific Ocean. County and prefecture names are indicated. (a) The U.S. and Japan. (b) San Francisco Bay Area. (c) Tokyo Bay Area. Source: Maps adapted from Google Map.

The San Francisco Bay Area is comprised of nine counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma. In this study, Santa Cruz County was also included in the SFB (Figure 2b). The size of the area is approximately 7,600 square miles and the region supports more than seven million

people from various ethnic backgrounds (Bay Area Census 2010). The southern region known as Silicon Valley is home to the world's leading technology companies, whereas the northern region, such as Napa and Sonoma, is famous for agriculture. The main means of transportation in this region is an automobile. Its Mediterranean climate is characterized by hot dry summers and cool wet winters. This region contains several national and state parks that cover various natural habitats. Some habitats such as salt marshes in the San Francisco Estuary are especially important for supporting a number of endangered and threatened species. This region is known as one of the biodiversity hot spots in the world (Myers et al. 2000).

The Tokyo Bay Area, in this study, refers to the area around Tokyo Bay, including Tokyo metropolitan, Saitama, Chiba, and Kanagawa prefectures (Figure 2c). The approximate size of the area is 5,200 square miles and its population size is 35 million, the majority of which are ethnically Japanese (Ministry of Internal Affairs and Communications 2014). Tokyo metropolitan works as the center of the nation's economy and politics, while the other three prefectures support those activities by providing residential areas and farms. The main means of transportation in this region is public transportation including subways, trains, and buses. The climate in this region is characterized by a temperate marine climate with four distinct seasons and two heavy rainy periods known as *tsuyu* and typhoon. Although most of the area is well-developed urban cities, some natural habitats are reserved as national and prefectural parks and gardens. Larger natural habitats such as mountain ranges are accessible in about 2-3 hours by public transportation.

To summarize, the population in the SFB is much less dense compared to that in the TB, and the SFB has more natural habitats inside and around the area. Furthermore, environmental education is more widely implemented in the U.S. compared to Japan. These facts suggest a higher chance for the SFB population to engage in nature-related activities and to obtain environmental knowledge than the TB population.

## Problem Statement

The value-belief-norm theory suggests that values and beliefs are the fundamental factors that shape pro-environmental behavior. Two measures (the Connectedness to Nature Scale and the New Ecological Paradigm scale) have been widely used in the environmental literature to measure the respondents' sense of connectivity with nature (as an indicator of biospheric values) and general environmental beliefs. Various studies have been conducted to investigate how demographic variables and education variables influence people's environmental attitudes (i.e., values and beliefs). No study, however, has been conducted that includes dimensions of social and cultural contexts, different approaches to environmental education, and periods of learning altogether. This study systematically analyzed the importance of these various factors on the development of students' environmental attitudes.

## Research Objectives

The purpose of this study was to increase our understanding of how environmental education influences university students' attitudes toward nature, a basis of pro-environmental behavior. Specifically, this study investigated how nature-related experiences and environmental knowledge obtained during childhood and in college influence the sense of connectedness to nature and ecological worldview of students of different social and cultural backgrounds, focusing on the Tokyo Bay Area, Japan, and the San Francisco Bay Area, California.

**Questions and Hypotheses**

Q.1 How does environmental education during childhood and university periods relate to students' attitudes toward nature?

$H_1$: I predicted that all environmental education variables (CE: childhood experience; CK: childhood knowledge; UE: university experience; and UK: university knowledge) would correlate significantly and positively with the Connectedness to Nature Scale (CNS) and the New Ecological Paradigm (NEP) scale. More specifically:

$H_{1\text{-}1}$: The childhood variables (CE and CK) would correlate more strongly with the CNS and the NEP than the university variables (UE and UK).

$H_{1\text{-}2}$: The experience variables (CE and UE) would correlate more strongly with the CNS than the NEP.

$H_{1\text{-}3}$: The knowledge variables (CK and UK) would correlate more strongly with the NEP than the CNS.

Q. 2 How do the academic backgrounds of university students relate to their university experience and knowledge about the environment?

$H_{2\text{-}1}$: I predicted that environmental-related major students would have higher average UE/ UK scores than non-environmental-related major students.

$H_{2\text{-}2}$: Upper division students would have higher average UE/ UK scores than lower division students.

$H_{2\text{-}3}$: Students in American universities would have higher average UE/ UK scores than those in Japanese universities.

Q. 3 How do the social and cultural backgrounds of university students relate to their childhood experience and knowledge related to the environment?

$H_{3\text{-}1}$: I predicted that students whose parents have higher academic degree (among the five categories in the survey) would have higher average CE/ CK scores than students whose parents have lower academic degree.

$H_{3\text{-}2}$: Students with higher annual family income (among the five categories in the survey) would have higher average CE/ CK scores than students with lower family income.

$H_{3\text{-}3}$: Students in the San Francisco Bay Area would have higher average CE/ CK scores than those in the Tokyo Bay Area.

Q.4 How do the social and cultural backgrounds of university students relate to their attitudes toward nature?

$H_4$: I predicted that scores of both CNS and NEP would differ significantly among university students of different demographic status. Specifically, after controlling the differences in environmental education variables:

$H_{4\text{-}1}$: Students who believe in Buddhism would have higher average CNS/ NEP scores than those who believe in Christianity.

$H_{4\text{-}2}$: Female students would have higher average CNS/ NEP scores than male students.

$H_{4\text{-}3}$: Students in the Tokyo Bay Area would have higher average CNS/ NEP scores than those in the San Francisco Bay Area.

# METHODS

## Study Site

### Universities in the San Francisco Bay Area

Students from three universities in the San Francisco Bay Area; namely 1) San José State University; 2) University of California, Santa Cruz; and 3) Santa Clara University participated in this study (Figure 3).


Figure 3. Geographical locations and pictures of the university campuses in the San Francisco Bay Area. Numbers in front of the names of university represent sample numbers in this study. Source: Map adapted from Google Map and photographs from Google Image.

San José State University (SJSU) is located in downtown San Jose, approximately 10 miles away from the southern edge of San Francisco Bay. Despite its small campus size (154 acres), it offers variety of academic programs including more than 130

undergraduate and graduate (master's only) courses. The total enrollment in Fall 2013 was 31,049 students; about 80% of which were undergraduates and over 90% were California residence (San José State University 2014a). The number of male students and female students were very comparable, and the major ethnicities were Asian (32%), White (24%), and Hispanic (22%). The Department of Environmental Studies was founded in 1970, as one of the first environmental-related programs in the U.S. It offers systematic and integrated approach to environmental studies, focusing on the sustainability of today's society (San José State University 2014b).

University of California, Santa Cruz (UCSC), is located at the southern edge of San Francisco Bay Area, approximately 40 miles away from the bay. The size of main campus is quite big (2,000 acres), and students can enjoy nature such as redwood forests, farms, and beautiful ocean views. It is an internationally well-known public research university committed to both undergraduate and graduate programs. The total enrollment in Fall 2013 was 17,203 students; about 90% of which were undergraduates and over 80% were California residence (University of California, Santa Cruz 2014a). The number of female students was slightly higher than that of male students and the major ethnicities were White (37%), Hispanic (30%), and Asian (25%). The Environmental Studies department provides interdisciplinary curriculum and unique research opportunities, focusing on the connections between environment and society (University of California, Santa Cruz 2014b).

Santa Clara University, located about six miles away from the southern edge of San Francisco Bay, is a private university based on Jesuit, Catholic values and traditions.

The 106-acre campus is located in an urban area but is surrounded by a beautiful rose garden and palm trees. It offers variety of undergraduate curriculum and their graduate programs are highly recognized in the U.S. The total enrollment in Fall 2013 was 8,770 students; about 60% of which were undergraduates and about 60% were California residence (Santa Clara University 2014a). The number of male students and female students were quite comparable for undergraduates, and the major ethnicities were White (48%), Hispanic (18%), and Asian (16%). The Department of Environmental Studies and Sciences offers interdisciplinary courses to help students to integrate their knowledge and research to promote a sustainable world (Santa Clara University 2014b).

**Universities in the Tokyo Bay Area**

Students from seven universities in the Tokyo Bay Area; namely 4) Soka University; 5) Yokohama National University; 6) The University of Tokyo; 7) Tokyo Gakugei University; 8) Saitama University; 9) Kyoei University; and 10) Aoyama Gakuin University participated in this study (Figure 4).

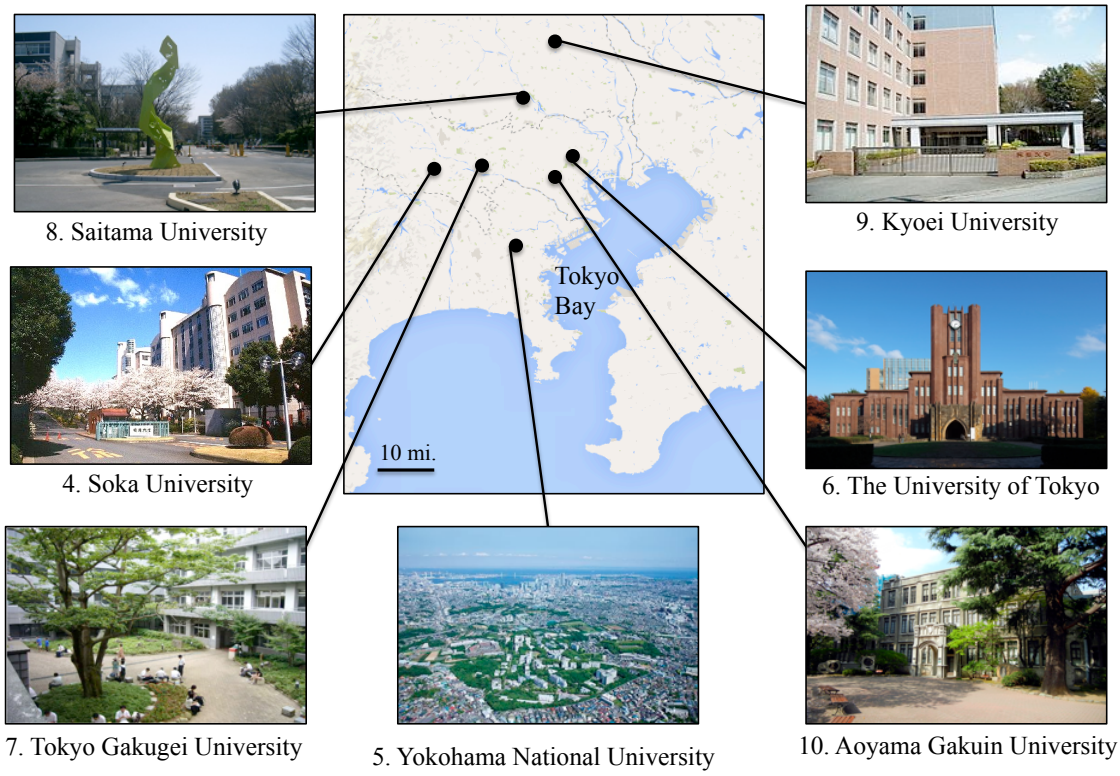


Figure 4. Geographical locations and pictures of the university campuses in the Tokyo Bay Area. Numbers in front of the names of university represent sample numbers in this study. Source: Map adapted from Google Map and photographs from Google Image.

Soka University is located in the west part of Tokyo, approximately 29 miles away from the Tokyo Bay. Its 215 acres of campus is surrounded by beautiful natures such as thousands of cherry blossoms and a lake. It is a private university based on a humanistic philosophy of value-creating (*Soka)* pedagogy, originally proposed by Makiguchi (1993). The majority of students are associated with Soka Gakkai, an international lay Buddhist organization, thus believing in Buddhism. The total enrollment in Spring 2014 was 8,005 students; most of which were undergraduates and the male population was slightly bigger than the female population (Soka University 2014a). The Department of Environmental Engineering for Symbiosis offers two

distinctive courses (one is related to civil engineering and the other is related to biology and ecology) and promotes the symbiotic relationship between people and nature (Soka University 2014b).

Yokohama National University is located in Kanagawa prefecture, near the western edge of Tokyo Bay. Although it is located in a developed city area, the campus (113 acres) has plenty of trees and beautiful ocean views. It is a highly ranked public university and offers undergraduate and graduate programs in several academic fields. The total enrollment in Spring 2014 was 10,032 students; about 75% of which were undergraduates and over 70% were male students (Yokohama National University 2014a). The Department of Civil and Environmental Engineering focuses on ocean engineering and ecology, offering variety of unique research projects (Yokohama National University 2014b).

The University of Tokyo is located in the center of the Tokyo metropolitan, approximately six miles away from the Tokyo Bay. One of the main campuses (*Hongo*; 100 acres) is famous for its historic and old building atmosphere. It is the top public university in Japan for both undergraduate and graduate programs, and its alumni are the leading figures in the nation's politics and economics. The total enrollment in Spring 2014 was 27,865 students; about half of which were undergraduates and more than 75% were male students (The University of Tokyo 2014a). The Department of Earth and Planetary Environmental Science focuses on the systematic understanding of the dynamic mechanism of life and the environment (The University of Tokyo 2014b).

Tokyo Gakugei University is located in the west part of Tokyo, approximately 20 miles away from the Tokyo Bay. The size of main campus in Koganei city is about 75 acres and has small forests, creeks, and city parks around the campus. This is a public university, which aims to foster educators who respect human rights and a peaceful society. A variety of educational and liberal arts programs are offered to the students, most of whom are thinking about elementary and secondary school teaching as their future careers. The total enrollment of undergraduates in Spring 2014 was 4,947 students; about 55% of which were female (Tokyo Gakugei University 2014a). The Department of Environmental Education promotes the appreciation toward the nature and culture of local community, focusing on hands-on learning through field studies (Tokyo Gakugei University 2014b).

Saitama University is located in the east part of Saitama prefecture, approximately 24 miles away from the northern edge of Tokyo Bay. It is a public university offering education, economics, science, and engineering-related undergraduate and graduate programs. The main campus (65 acres) is located in an urban area but has rivers and city parks around the campus. The total enrollment in Spring 2014 was 7,315 students; about 33% of which were female (Saitama University 2014a). The Department of Environmental Science offers small-class learning experiences, focusing on matter/ energy cycles, ecology, and environmental assessment (Saitama University 2014b).

Kyoei University is located in the northeast part of Saitama prefecture, approximately 30 miles away from the northern edge of Tokyo Bay. It is a relatively new (founded in 2001) private university, offering two major academic programs including

international business administration and education. Its 63 acres of campus is located in a suburban area, providing students a quite space for study. The total enrollment in Spring 2014 was 1,128 students; about 70% of which were male (Kyoei University 2014a). The Department of Education offers wide range of educational courses including Environmental Education (Kyoei University 2014b).

Aoyama Gakuin University, a private Protestant mission school, is located in the center of the Tokyo metropolitan, approximately two miles from the Tokyo Bay. Its main campus in Tokyo is very small (17 acres) and there are several municipal parks and national gardens in the area. It offers variety of undergraduate and graduate programs. The total enrollment in Spring 2014 was 18,737 students; over 90% of which were undergraduates and the male population was slightly bigger than the female population (Aoyama Gakuin University 2014a). The Department of Chemistry and Biological Science is the closest environmental-related major, but the university offers many introductory level courses that related to the environment to the students from all majors (Aoyama Gakuin University 2014b).

Students from one educational course ($n$ = 25) in Joetsu University of Education, Nigata, also participated in the survey; however, their responses were excluded from the analysis because this university is located outside of the Tokyo Bay Area.

## Study Design

### Population and Sampling

The target population of this study was the undergraduate students who were enrolled in the 2013-14 academic year in the universities in the SFB and TB. Although random sampling is the desired sampling method in most social science research, it was difficult to obtain a random sample in this study due to limited access to university students' personal information and university classes. Therefore, a convenience sampling method, which relies on the available subjects to researcher, was utilized for this study. The results of this study should not be generalized into the entire population. Rather, this study should be treated as a case study that tests the hypotheses established based on previous research.

In order to obtain samples from a variety of demographic and academic backgrounds, several universities were selected based on the university type (public or private), university level (teaching or research), and campus environment (urban or suburban). Both environmentally-related courses and non-environmentally-related courses were selected as potential targets. Undergraduate students were the focus of this study; however, graduate students who were taking the visited undergraduate classes were included in the analysis. In total, 2,615 students from 100 undergraduate courses from 10 universities and seven distinctive departments were contacted.

**Survey Design**

The questionnaire consisted of five sections (Appendix C and D). The first and last sections were composed of five multiple-choice questions and three short answer questions asking respondents' basic demographic and academic information including gender, age, university, year, major, religion, parents' education, and annual family income. Questions about religion, parents' education, and annual family income were presented in the last section of the survey as they are more personal in nature. The second section was composed of 20 Likert-type questions on respondents' nature-related experiences and environmental knowledge obtained during childhood and university period. The third section asked respondents of their current attitudes toward nature based on the six CNS items (Mayer and Frantz, 2004) and six NEP items (Dunlap et al., 2000). The fourth section was comprised of two multiple-choice questions and two open-ended questions that are designed to ask respondents' most influential factors and most memorable experiences related to environmental education.

Analyzing correlations between data derived from Section II (environmental education variables) and Section III (environmental attitude variables) helped to answer the first research question: Q.1 How does environmental education during childhood and university periods relate to students' attitudes toward nature?" Data derived from Section I & V (academic and demographic variables) were used to answer the research questions: Q.2 How do the academic backgrounds of university students relate to their university experience and knowledge related to the environment?, Q.3 How do the social and cultural backgrounds of university students relate to their childhood experience and

knowledge related to the environment?, and Q.4 How do the social and cultural backgrounds of university students relate to their attitudes toward nature (Figure 5)? Data from the fourth section of the survey were analyzed qualitatively to add more in-depth insights into the results from quantitate analysis.

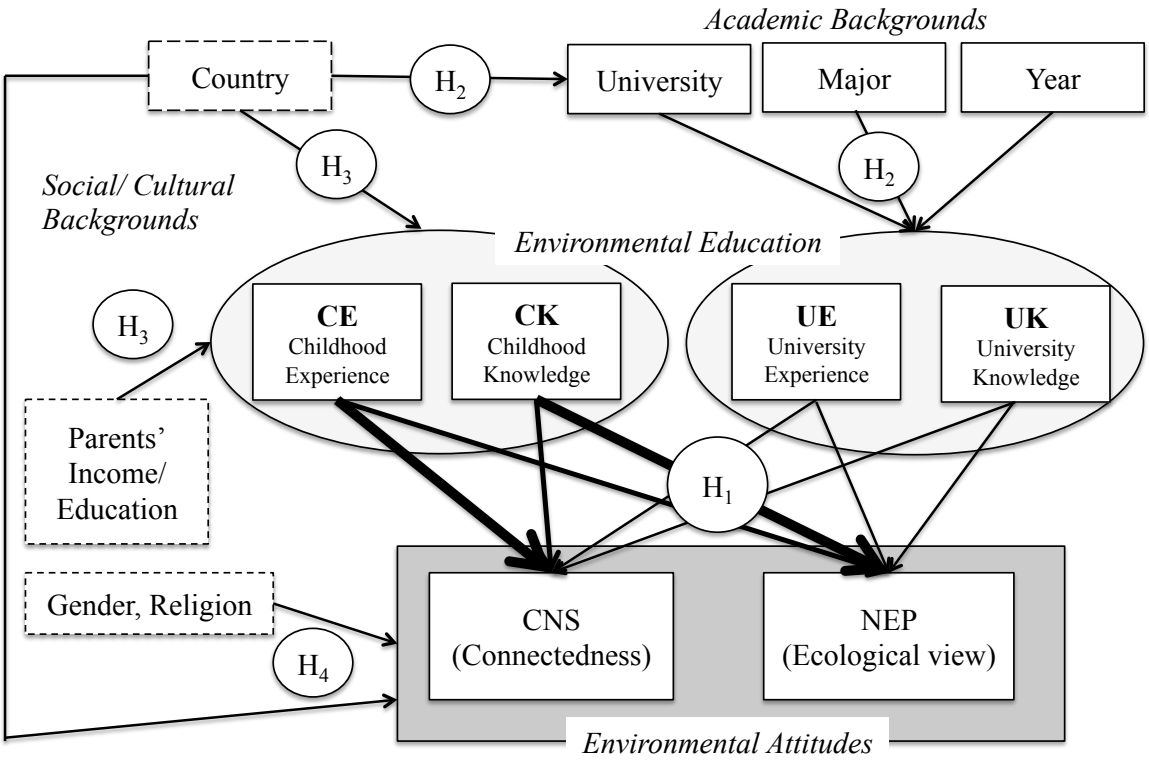


Figure 5. Expected relationships between $H_1$: environmental education variables and environmental attitude variables; $H_2$: academic backgrounds and university education variables; $H_3$: social/cultural backgrounds and childhood education variables; and $H_4$: social/cultural backgrounds and environmental attitude variables. $H_1$~$H_4$ corresponds to the research hypotheses in this paper. Bolder arrows indicate stronger correlations between the variables.

## Data Collection

### Questionnaire Construction

A questionnaire containing a cover sheet, which served as an informed consent form, and the series of questions was created using an online survey software called SurveyMonkey (SurveyMoneky Inc.). The questionnaire was constructed using English first, and then each sentence was translated into Japanese. Three researchers conducted the translation separately and the best wording was selected based on the combined results. Administration of the survey began after obtaining an approval from San José State University Institutional Review Board (IRB) as well as other institutions that required separate IRB approval (Santa Clara University and Soka University). A pilot study with 11 undergraduate students in each region was conducted in July 2013, in order to test the reliability and validity of questions. Small revisions were made based on the responses to the pilot survey.

### Survey Administration

Potential target classes were randomly selected from the university catalog. The initial contact was made by email with each potential instructor. The email contained a short explanation of the research and instruction of the survey administration. In Japanese universities, instructors who agreed to support this research distributed the invitation letter (Appendix B) to the students during the class. Due to a request from instructors in Yokohama National University, Saitama University, and Kyoei University, a paper-based survey was conducted at the end of the class in these universities. A few

demographic questions (parents' education, annual family income, and religious affiliation) and open-ended questions were eliminated for the paper questionnaire, considering the time constraints. In American universities, after the initial contact with the instructors, the primary researcher visited every class to distribute the invitation letter (Appendix A) to the students. When personal visitation was not possible, the instructor distributed the letter or sent it by email to the students.

After receiving the invitation letter, students had about a month to complete the online survey. The invitation letter contained a link to the survey and the participants were asked to access to it by the set due date. The first page of online questionnaire included the elements of informed consent. When students clicked a "Next" button, it was implied that they had read and understood the information provided on the page. Once they answered all the questions, they were directed to a "thank you" page and the survey finished. The primary researcher tracked the responses over time and sent follow-up emails twice to the responsible instructors, one in the middle of the month, and the second a few days before the due date. The instructors reminded their students during the class after receiving those emails. Data collection was conducted from September to December 2013 in Japanese universities and San José State University, then from February to May 2014 in UC, Santa Cruz and Santa Clara University. Responses from online survey were automatically saved in an electric database, whereas responses from paper surveys were sent to the primary researcher and manually entered into the electric database.

## Data Analysis

### Quantitative Data Analysis

Data derived from the closed-ended survey questions described in the previous section were quantitatively analyzed using IBM SPSS Statistics 20.

*Independent and dependent variables*

Independent variables included eight demographic variables, including country, gender, religion, parents' education, annual family income, university, year, and major. Four environmental education indexes (CE: childhood experience; CK: childhood knowledge; UE: university experience; and UK: university knowledge) were used as independent and dependent variables depending on the purpose of analysis. Dependent variables included two environmental attitude indexes, the CNS (Connectedness to Nature Scale) and the NEP (New Ecological Paradigm). Most of the demographic variables were nominal measures (except parents' education, annual family income, and year, which were ordinal measures), whereas all of the environmental education and attitude indexes were ordinal measures and they were treated as continuous variables (Table 1).

Table 1. List of the independent and the dependent variables used in this study and their levels of measurement

| Variable Name | Levels of Measurement | Independent/ Dependent |
|---|---|---|
| Demographic Variables | | |
| Country | Nominal | IV |
| Gender | Nominal | IV |
| Religion | Nominal | IV |
| Parents' Education | Ordinal | IV |
| Annual Family Income | Ordinal | IV |
| Academic Variables | | |
| University | Nominal | IV |
| Year | Ordinal | IV |
| Major | Nominal | IV |
| Environmental Education Variables | | |
| Childhood Experience (CE) | Ordinal (Continuous) | IV/ DV |
| Childhood Knowledge (CK) | Ordinal (Continuous) | IV/ DV |
| University Experience (UE) | Ordinal (Continuous) | IV/ DV |
| University Knowledge (UK) | Ordinal (Continuous) | IV/ DV |
| Environmental Attitude Variables | | |
| Connectedness to Nature Scale (CNS) | Ordinal (Continuous) | DV |
| New Ecological Paradigm (NEP) | Ordinal (Continuous) | DV |

*Notes:* IV: Independent variable. DV: Dependent variable. Indexes were treated as continuous measures.

*Quantification of data*

All demographic variables were coded according to the codebook (Appendix E). The coded variables were sometimes recoded into new variables in order to reduce the number of categories (e.g., Major was recoded into MajorR with only environmental-related major vs. all non-environmental-related majors). Missing data were coded as 99 and excluded from the analysis.

For environmental education variables, respondents were asked to indicate, based on a 6-point Likert scale, their levels of involvement in (or understanding of) childhood

experience (CE), childhood knowledge (CK), university experience (UE), and university knowledge (UK) related to the environment. Possible responses ranged from 1 (= never/ not at all) to 6 (= almost all the time/ a significant amount). The score for each item was summed up and divided by the number of items to create each index. Missing values were replaced by the index mean for each respondent. The created indexes consisted of five items each and the maximum possible score was 6.

For environmental attitude variables, respondents were asked to indicate, based on a 6-point Likert scale, their levels of agreement to each statement about their sense of connectedness to nature (CNS) and ecological worldview (NEP). Possible responses ranged from 1 (= strongly disagree) to 6 (strongly agree). After reversing the scores for negatively worded items, the score for each item was summed up and divided by the number of items to create each index. Missing values were replaced by the index mean for each respondent. The created indexes consisted of six items each and the maximum possible score was 6.

*Analytical methods*

Descriptive statistics of the variables (i.e., frequency distribution and central tendency) were calculated for each university sample, the SFB sample (three universities total), the TB sample (seven universities total), and ALL (ten universities total). The Cronbach's coefficient and factor loadings were calculated for the constructed indexes to check the reliability and uni-dimensionality. Principal component analysis was used as an extraction method. When the index was composed of more than two components,

items that had factor loadings (of the 1st component) smaller than .50 were eliminated from the final index.

Bivariate correlation and sequential multiple regression analysis were conducted to measure the correlations between the four environmental education variables and the two environmental attitude variables. In the sequential multiple regression analysis, childhood variables were included in model 1, university variables were added into model 2, and the best-fit model (model 3) was determined using a backward-elimination method (i.e., insignificant variables were removed from the model 2 with the least significant variable at once). Path diagrams were created based on the results of correlation and regression analysis.

Most of the variables showed normal bell-shaped distribution and there was no extra ordinal data; however, some variables were highly skewed, especially when the sample size was small. Therefore, a non-parametric statistical test (i.e., Mann-Whitney *U* test, Kruskal-Wallis test and Dunnett's T3 post hoc test) was used when comparing scores between groups.

In order to analyze the relative importance of demographic variables on students' environmental attitudes, sequential multiple regression analysis was conducted. For this analysis, all significant environmental education predictors (those included in the previous model 3 equation) were entered at simultaneously into model 1. Then demographic variables in questions were added into model 2 and the values of adjusted $R^2$ were compared between the model 1 and the model 2. When analyzing the relative importance of country on the CNS/ NEP, all education variables were entered at once in

model 1 and the best-fit model was determined in model 2 by a backward-elimination method. Finally, country variable was added into model 3 and the values of adjusted $R^2$ were compared between the model 2 and the model 3.

**Qualitative Data Analysis**

Data derived from the open-ended questions were qualitatively analyzed, following the steps described below (Burnard 1991).

*Open coding*

All transcripts were read through several times, and any categories that appeared in the transcripts were written down. In this step, the categories covered almost all aspects of the content.

*Making a list of categories*

The initial list of categories were investigated in order to group similar categories into broader categories. During this step, categories were divided into main headings and several sub-headings. Transcripts were reviewed again alongside the revised list of categories in order to make sure that the revised version of category system covered all aspects of the respondents' ideas. Adjustments were made to create the final list of categories.

*Coding*

Each transcript was worked through with the final list of categories and sentences were coded according to the category system. Different colors were used to highlight the different themes. After coding, the frequency of citing (i.e., how many times each

category was cited by the respondents) was counted and percentiles were calculated for each sub-heading. This enabled the quantitative analysis of the data as well.

*Making connections*

All the transcripts were investigated carefully to see how each category connects the others. For example, the relationships between activities (camping, hiking etc.) and how the respondents felt through those activities were analyzed. In this step, various data elements were logically analyzed in order to create a comprehensive narrative of the data (Figure 6). Representative transcripts that clearly demonstrated the important ideas were selected.

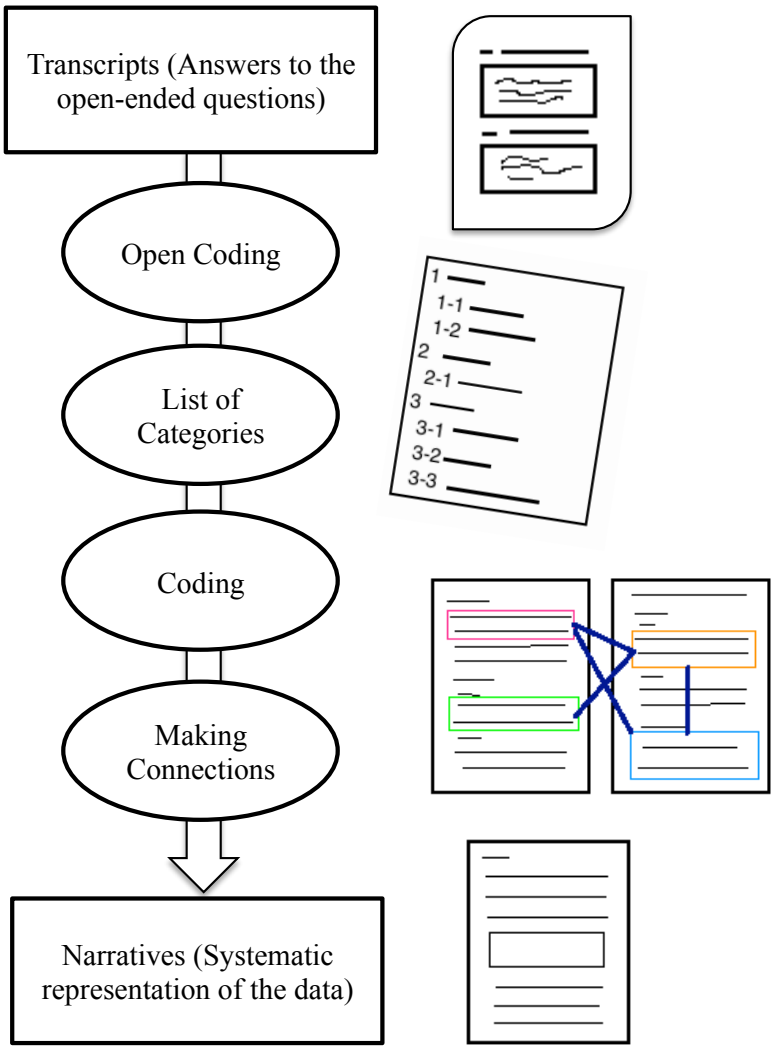


Figure 6. The process of qualitative analysis used in this study. There are four main steps (open coding, making a list of categories, coding, and making connections) to create the narratives from the transcripts.

# RESULTS

## Overview

According to the results of correlation and regression analysis, both childhood and university education variables were significantly correlated with the CNS and the NEP; where university education was more strongly correlated with the attitude variables. Major, year, and university had significant influences on university education, while parents' education level, annual family income, and country had significant influences on childhood education. Demographic variables including religion, gender, and country had some direct effects on the CNS and the NEP; however, their influences were relatively small compared to environmental education.

School was the most important resource of environmental education in both regions, where students obtained nature-related experiences and environmental knowledge. Respondents shared how their various experiences, such as hiking, camping, lectures, watching documentaries etc., have shaped their positive attitudes toward nature. Memorable nature experiences occurred more frequently in younger age (< 11-years-old), whereas influential-learning experiences occurred mostly at university period (> 18-years-old).

**Summary Data of Demographic and Academic Variables**

Of the original 1,301 responses, thirty-five were discarded because they did not answer most (>90%) of the questions. This resulted in 1,266 responses for an overall response rate of 48% (Table 2). The response rate of the SFB sample ($n$ = 470) was relatively low (33%), while that of the TB sample ($n$ = 796) was high (67%) for online/ paper-based survey. Demographic data included gender, age, religion, parents' education and annual family income. As for the SFB sample, over half of the respondents (58%) were female, with an average age of 22.4. Nearly half of the respondents (46%) answered that they were non-religious, followed by Christian (36%). The median of parents' education was bachelor's degree and that of annual family income was $75,000~$99,999. Regarding the TB sample, there were more male students (58%) than female students, with an average age of 20.4. The majority of the respondents (84%) were Buddhist, followed by non-religious affiliation (15%). The median of parents' education was bachelor's degree and that of annual family income was $50,000~$74,999. Academic data included year and major. The majority (78.0%) of the respondents were upper division students in the SFB sample and over half (54%) of the respondents were also upper division in the TB sample. Many students (63%) majored in environmental-related subjects in the SFB sample, while nearly two-thirds of the respondents (64%) were majoring in non-environmental-related subjects in the TB sample.

Table 2. Demographic and academic characteristics of the SFB and TB sample and their total data (ALL)

| Sample | SFB | TB | ALL |
|---|---|---|---|
| Sample size (*n*) | 470 | 796 | 1266 |
| Response Rate % | 33.1 | 66.6 | 48.4 |
| Gender | | | |
| Male (%) | 197 (42.3) | 464 (59.0) | 661 (52.8) |
| Female (%) | 269 (57.7) | 322 (41.0) | 591 (47.2) |
| Age | | | |
| *M* | 22.4 | 20.4 | 21.2 |
| *SD* | 4.4 | 1.4 | 3.1 |
| Religion | | | |
| Buddhist (%) | 36 (8.4) | 313 (84.1) | 349 (43.7) |
| Christian (%) | 155 (36.3) | 1 (0.3) | 156 (19.5) |
| Other (%) | 38 (8.9) | 4 (1.1) | 42 (5.3) |
| Non-religious (%) | 198 (46.4) | 54 (14.5) | 252 (31.5) |
| Parents' Education | | | |
| < High school[a] (%) | 84 (19.6) | 115 (30.5) | 199 (24.7) |
| < Bachelor's[b] (%) | 219 (51.2) | 242 (64.2) | 461 (57.3) |
| < PhD[c] (%) | 125 (29.2) | 20 (5.3) | 145 (18.0) |
| Annual Family Income | | | |
| ~$24,999 | 67 (16.5) | 45 (12.4) | 112 (14.6) |
| ~$49,999 | 57 (14.0) | 109 (30.1) | 166 (21.6) |
| ~$74,999 | 64 (15.7) | 102 (28.2) | 166 (21.6) |
| ~$99,999 | 65 (16.0) | 57 (15.7) | 122 (15.9) |
| >$100,000 | 154 (37.8) | 49 (13.5) | 203 (26.4) |
| Year | | | |
| Lower[d] (%) | 83 (17.9) | 356 (45.5) | 439 (35.2) |
| Upper[e] (%) | 362 (78.0) | 424 (54.0) | 786 (63.0) |
| Graduate (%) | 19 (4.1) | 4 (0.5) | 23 (1.8) |
| Major | | | |
| Environmental[f] (%) | 296 (63.1) | 282 (36.0) | 578 (46.2) |
| Other[g] (%) | 173 (36.9) | 501 (64.0) | 674 (53.8) |

*Notes*: SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB.
[a]Graduated from middle school, high school, or less than middle school.
[b]Graduated from 2-year college or 4-year university.
[c]Obtained Master's degree or PhD degree.
[d]Lower division refers to the freshman- and sophomore-standing in the university.
[e]Upper division refers to the junior- and senior-standing in the university.
[f]Environmental-related-subjects include Environmental Studies, Environmental Science, Biology, Environmental/ Biology Education.
[g]Other: All non-environmental-related subjects.

## Index Construction and Reliability Test

### Reliability Test

The reliabilities of the four environmental education indexes (CE, CK, UE, and UK) were medium low to very high (Cronbach's alpha = .62~ .91). Only one component was extracted for most of the samples. Although two components were extracted for a few samples, all five items were used to create the indexes based on the relatively high factor loadings of the first component, ranging from .35 to .92, with an average value of .76 (Table 3).

The reliabilities of the initial environmental attitude indexes (CNS and NEP) were low (alpha = .51 ~ .69) primarily due to the two items in CNS (CNS2R and 5R) and three items in NEP (NEP1R, 3R, and 5R), which had factor loadings lower than .50. These five items were dropped, resulting in higher values of Cronbach's alpha for both indexes (Table 4). The NEP still had alpha values lower than .70; however, this index was regarded as reliable based on the fact that it consisted of only one factor, and that an index with a small number of items generally produces low values of alpha.

Table 3. Factor loadings and Cronbach's alpha for the four environmental education indexes (CE, CK, UE, and UK)

| Index/ Item | SFB ($n$ = 470) | TB ($n$ = 796) | ALL ($n$ = 1266) |
|---|---|---|---|
| | Standardized Factor Loading[a] | | |
| **CE (Childhood Experience)** | | | |
| CE1 | .68 | .61 | .64 |
| CE2 | .73 | .67 | .69 |
| CE3 | .87 | .77 | .80 |
| CE4 | .74 | .71 | .72 |
| CE5 | .65 | .69 | .66 |
| Eigenvalue | 2.72 | 2.38 | 2.49 |
| Percentage of variation explained | 54.4 | 47.6 | 49.8 |
| Cronbach's alpha | .79 | .72 | .75 |
| **CK (Childhood Knowledge)** | | | |
| CK1 | .79 | .75 | .78 |
| CK2 | .83 | .84 | .84 |
| CK3 | .89 | .85 | .87 |
| CK4 | .85 | .79[b] | .83 |
| CK5 | .82 | .70[b] | .77 |
| Eigenvalue | 3.51 | 3.10 | 3.34 |
| Percentage of variation explained | 70.1 | 62.0 | 66.8 |
| Cronbach's alpha | .89 | .85 | .88 |
| **UE (University Experience)** | | | |
| UE1 | .75 | .35 | .53 |
| UE2 | .83 | .68 | .75 |
| UE3 | .79 | .72 | .79 |
| UE4 | .77 | .73 | .78 |
| UE5 | .69 | .62 | .71 |
| Eigenvalue | 2.95 | 2.02 | 2.59 |
| Percentage of variation explained | 58.9 | 40.5 | 51.9 |
| Cronbach's alpha | .82 | .62 | .76 |
| **UK (University Knowledge)** | | | |
| UK1 | .55[b] | .73[b] | .72 |
| UK2 | .83[b] | .82[b] | .86 |
| UK3 | .92 | .89 | .92 |
| UK4 | .89 | .83 | .83 |
| UK5 | .85 | .82 | .87 |
| Eigenvalue | 3.34 | 3.36 | 3.64 |
| Percentage of variation explained | 66.7 | 67.2 | 72.8 |
| Cronbach's alpha | .87 | .88 | .91 |

*Notes:* Questions of all items are listed in Appendix E. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB.

[a]Extraction method: Principal component analysis.

[b]The second component loaded higher for that item in the rotated component matrix; Rotation method: Varimax with Kaiser normalization.

Table 4. Factor loadings and Cronbach's alpha for the two environmental attitude indexes (CNS and NEP)

| Index/ Item | SFB ($n$ = 470) | TB ($n$ = 796) | ALL ($n$ = 1266) |
|---|---|---|---|
| | Standardized Factor Loading[a] | | |
| **CNS (initial)** | | | |
| CNS1 | .80 | .70 | .76 |
| CNS2R | .50[b] | -.29[b] | .14[b] |
| CNS3 | .71 | .70 | .74 |
| CNS4 | .72 | .73 | .77 |
| CNS5R | .18[b] | .42[b] | .30[b] |
| CNS6 | .75 | .73 | .76 |
| Eigenvalue | 2.51 | 2.23 | 2.44 |
| Percentage of variation explained | 41.8 | 37.2 | 40.7 |
| Cronbach's alpha | .69 | .59 | .66 |
| **CNS (revised)** | | | |
| CNS1 | .81 | .71 | .78 |
| CNS3 | .73 | .72 | .75 |
| CNS4 | .75 | .74 | .78 |
| CNS6 | .76 | .75 | .77 |
| Eigenvalue | 2.33 | 2.12 | 2.37 |
| Percentage of variation explained | 58.1 | 53.1 | 59.3 |
| Cronbach's alpha | .76 | .71 | .77 |
| **NEP (initial)** | | | |
| NEP1R | .42[b] | .31[b] | .45[b] |
| NEP2 | .59 | .64 | .64 |
| NEP3R | .42[b] | .25[b] | .24[b] |
| NEP4 | .78 | .77 | .79 |
| NEP5 | .58 | .65 | .66 |
| NEP6R | .66[b] | .47[b] | .62[b] |
| Eigenvalue | 2.08 | 1.73 | 2.09 |
| Percentage of variation explained | 34.6 | 28.8 | 34.9 |
| Cronbach's alpha | .61 | .51 | .60 |
| **NEP (revised)** | | | |
| NEP2 | .75 | .74 | .76 |
| NEP4 | .83 | .80 | .83 |
| NEP5 | .67 | .72 | .74 |
| Eigenvalue | 1.70 | 1.71 | 1.81 |
| Percentage of variation explained | 56.7 | 56.9 | 60.2 |
| Cronbach's alpha | .61 | .62 | .67 |

*Notes:* Questions of all items are listed in Appendix E. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB.

[a]Extraction method: Principal component analysis.

[b]The second component loaded higher for that item in the rotated component matrix; Rotation method: Varimax with Kaiser normalization.

**Frequency Distribution and Mean Statistics of the Indexes**

After creating six indexes, mean scores and standard deviations of the indexes were calculated (Table 5). With the exception of CE-CK in the TB sample, the average scores of knowledge indexes (CK/ UK) were higher than those of the comparable experience indexes (CE/ UE). The average scores of NEP were higher than those of CNS in both regions.

Table 5. Mean scores and standard deviations of the environmental education and attitude variables for the SFB and TB samples and their total data (ALL)

| Index | SFB ($n$ = 470) | | TB ($n$ = 796) | | ALL ($n$ = 1266) | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| CE | 3.84 | 0.92 | 3.60 | 0.85 | 3.69 | 0.88 |
| CK | 3.95 | 1.08 | 3.42 | 0.88 | 3.62 | 0.99 |
| UE | 3.15 | 1.16 | 2.24 | 0.82 | 2.57 | 1.06 |
| UK | 4.33 | 1.22 | 2.86 | 1.13 | 3.40 | 1.36 |
| CNS | 4.53 | 0.98 | 3.63 | 0.93 | 3.97 | 1.05 |
| NEP | 5.08 | 0.79 | 4.38 | 0.91 | 4.64 | 0.93 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB.

Histograms (Figures 7-9) were also created to see the distribution of data. The CE/ CK scores showed normal bell-shaped distribution, while the UE/ UK scores were somewhat skewed or had platykuric distribution. The CNS data, especially of the TB sample, showed normal bell-shaped distribution; on the other hand, the NEP data, especially of the SFB sample, were highly skewed, where the majority of respondents selected answer 5 (= Agree) or 6 (= Strongly Agree).

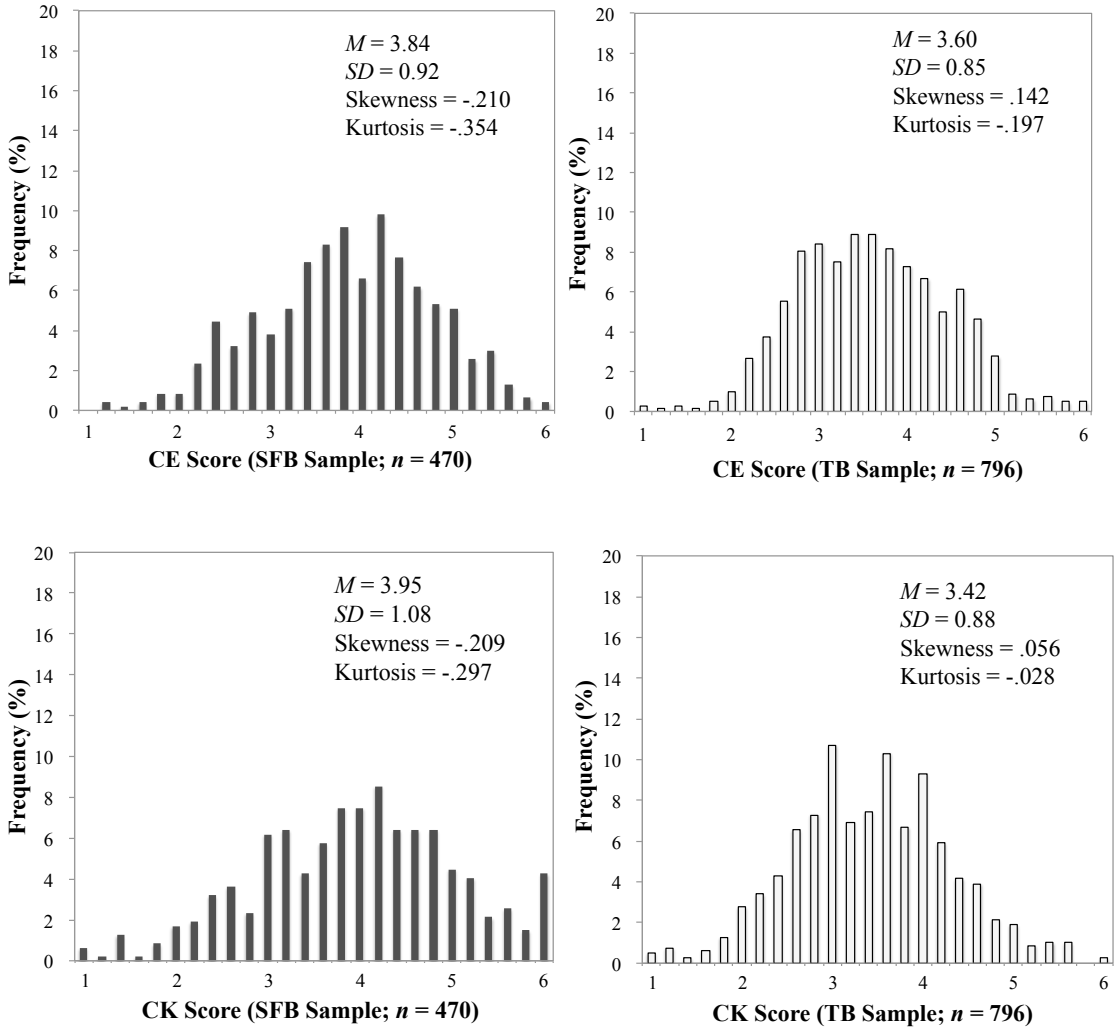


Figure 7. Frequency distribution of the CE/ CK scores for the SFB and TB samples. Means, standard deviations, skewnes, and kurtosis are shown in the graph. CE: Childhood Experience. CK: Childhood Knowledge. SFB: San Francisco Bay Area. TB: Tokyo Bay Area.

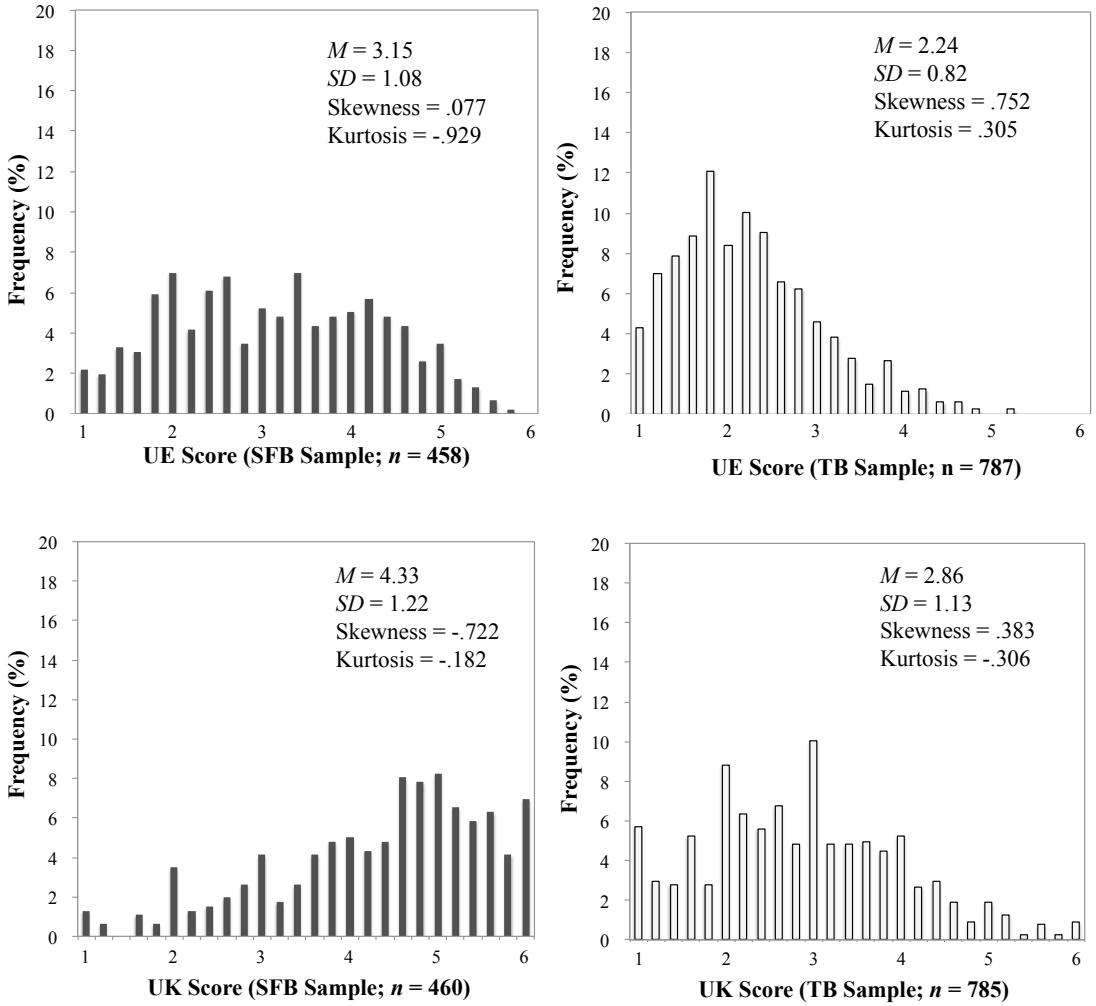


Figure 8. Frequency distribution of the UE/ UK scores for the SFB and TB samples. Means, standard deviations, skewnes, and kurtosis are shown in the graph. UE: University Experience. UK: University Knowledge. SFB: San Francisco Bay Area. TB: Tokyo Bay Area.

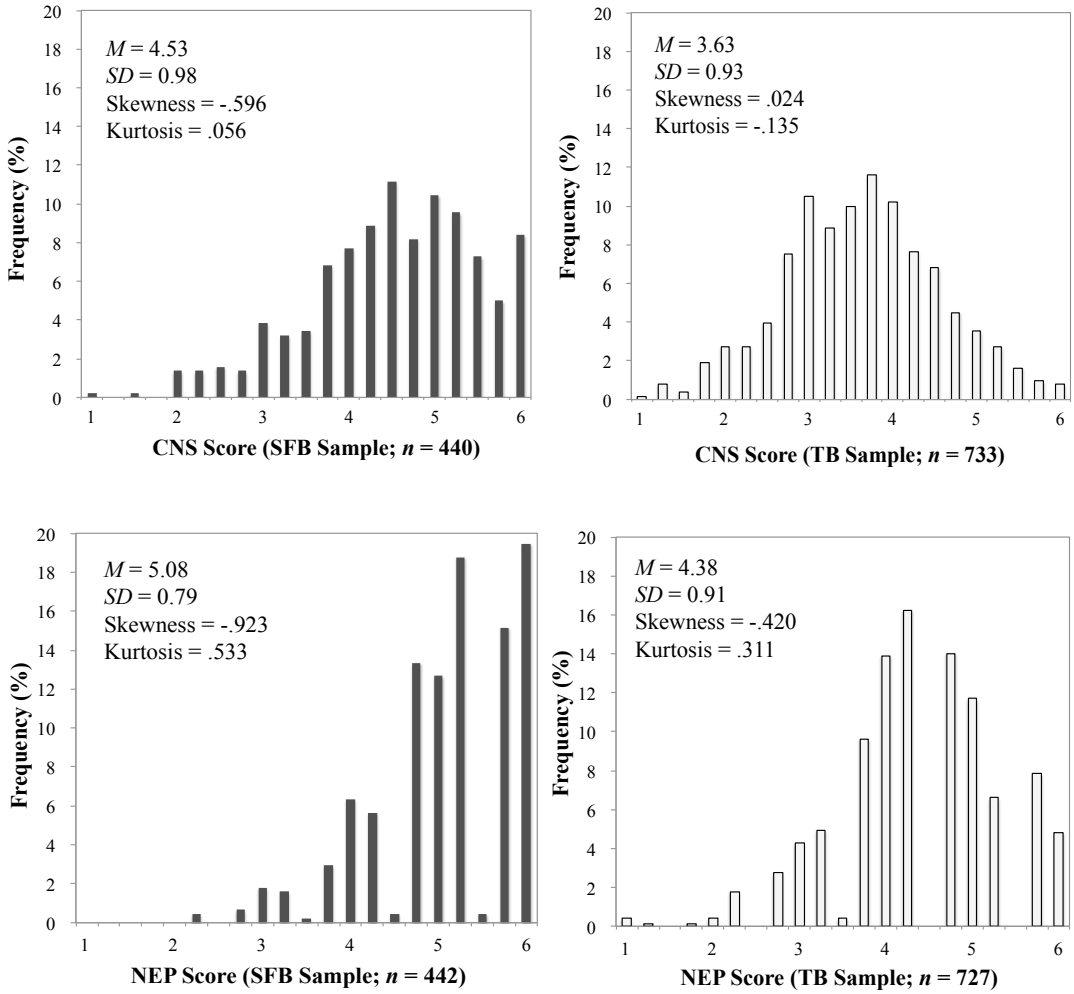


Figure 9. Frequency distribution of the CNS/ NEP scores for the SFB and TB samples. Means, standard deviations, skewnes, and kurtosis are shown in the graph. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm. SFB: San Francisco Bay Area. TB: Tokyo Bay Area.

## Creation of a Model

### Correlation Analysis

The four independent variables (CE, CK, UE, and UK) were positively correlated with each other in both SFB and TB samples. The average correlation between the four independent variables for the SFB sample was .31, with the highest correlation between the UE and the UK ($r = .60$, $p < .001$) (Table 6). As for the TB sample, the average correlation between the four independent variables was .33, with the highest correlation again between the UE and the UK ($r = .50$, $p < .010$) (Table 7). The two dependent variables (CNS and NEP) were significantly correlated with each other in both SFB sample, $r(436) = .40$, and TB sample, $r(724) = .26$, at $p < .001$.

Table 6. Correlations between the four independent variables (CE, CK, UE, and UK) and the two dependent variables (CNS and NEP) for the SFB sample

| | CE | CK | UE | UK | CNS | NEP |
|---|---|---|---|---|---|---|
| CE | – | .343** | .362** | .260** | .360** | .115** |
| CK | | – | .120* | .153** | .135** | -.025 |
| UE | | | – | .602** | .471** | .231** |
| UK | | | | – | .432** | .278** |
| CNS | | | | | – | .396** |
| NEP | | | | | | – |

*Notes:* SFB: San Francisco Bay Area ($n = 479$). CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.
*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 7. Correlations between the four independent variables (CE, CK, UE, and UK) and the two dependent variables (CNS and NEP) for the TB sample

| | CE | CK | UE | UK | CNS | NEP |
|---|---|---|---|---|---|---|
| CE | – | .345** | .363** | .203** | .307** | .105** |
| CK | | – | .265** | .332** | .214** | .115** |
| UE | | | – | .500** | .326** | .070 |
| UK | | | | – | .294** | .112** |
| CNS | | | | | – | .259** |
| NEP | | | | | | – |

*Notes:* TB: Tokyo Bay Area ($n$ = 796). CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.
**Correlation is significant at the 0.01 level (2-tailed).

**Multiple Regression Analysis**

As for the SFB sample, three variables, including CE ($b$ = .21, $p$ < .001), UE ($b$ = .27, $p$ < .001), and UK ($b$ = .22, $p$ < .001) were the significant predictors for the CNS. These three variables accounted for as much as 30% of the variation in the CNS, $F$(3, 434) = 60.43, $p$ < .001. Similar results were found for the TB sample, where CE ($b$ = .213, $p$ < .001), UE ($b$ = .166, $p$ < .001), and UK ($b$ = .164, $p$ < .001) were the significant predictors for the CNS. These variables explained 17% of the variation in the CNS, $F$(3, 727) = 48.89, $p$ < .001. For both samples, the model 2 (childhood + university) explained much higher variation in the CNS than the model 1 (childhood only) (Table 8).

Table 8. Comparison of the three sequential regression models for predicting the CNS

| | SFB (San Francisco Bay Area) | | | TB (Tokyo Bay Area) | | |
|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| | *b* | *b* | *b* | *b* | *b* | *b* |
| CE | .358*** | .215*** | .209*** | .266*** | .199*** | .213*** |
| CK | .009 | -.019 | | .40** | .051 | |
| UE | | .264*** | .265*** | | .164*** | .166*** |
| UK | | .221*** | .219*** | | .150*** | .164*** |
| *df1* | 2 | 4 | 3 | 2 | 4 | 3 |
| *df2* | 435 | 433 | 434 | 728 | 726 | 727 |
| *F* | 32.56*** | 45.29*** | 60.43*** | 44.35*** | 37.17*** | 48.89*** |
| *r* | .361 | .543 | .543 | .330 | .412 | .410 |
| $R^2$ | .130 | .295 | .295 | .109 | .170 | .168 |
| Adjusted $R^2$ | .126 | .288 | .290 | .106 | .165 | .164 |

*Notes:* ***Significant at $p < .001$. **Significant at $p < .01$. CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge
SFB Model 1 predictors: CE + CK
SFB Model 2 predictors: CE + CK + UE + UK
SFB Model 3 predictors: CE + UE + UK
TB Model 1 predictors: CE + CK
TB Model 2 predictors: CE + CK + UE + UK
TB Model 3 predictors: CE + UE + UK

Regarding the NEP variable, only UK ($b = .278$, $p < .001$) was left as the significant predictor in the SFB sample. The UK variable explained about 8% of the variance in the NEP, $F(1, 440) = 36.98$, $p < .001$. As for the TB sample, on the other hand, two variables, CE ($b = .084$, $p = .026$) and UK ($b = .094$, $p = .013$), were left as the significant predictors for the NEP; however, they accounted only 1.9% variance in the NEP, $F(2, 723) = 7.147$, $p = .001$ (Table 9).

Table 9. Comparison of the three sequential regression models for predicting the NEP

| | SFB (San Francisco Bay Area) | | | TB (Tokyo Bay Area) | | |
|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| | *b* | *b* | *b* | *b* | *b* | *b* |
| CE | .141** | .062 | | .074 | .070 | .084* |
| CK | -.073 | -.091 | | .088* | .066 | |
| UE | | .087 | | | -.016 | |
| UK | | .224*** | .278*** | | .083 | .094* |
| *df1* | 2 | 4 | 1 | 2 | 4 | 2 |
| *df2* | 437 | 435 | 440 | 723 | 721 | 723 |
| *F* | 4.02* | 11.01*** | 36.98*** | 6.57** | 4.25** | 7.15** |
| *r* | .134 | .303 | .278 | .134 | .152 | .139 |
| $R^2$ | .018 | .092 | .078 | .018 | .023 | .019 |
| Adjusted $R^2$ | .014 | .084 | .075 | .015 | .018 | .017 |

*Notes:* ***Significant at $p < .001$. **Significant at $p < .01$. *Significant at $p < .05$.
CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge
SFB Model 1 predictors: CE + CK
SFB Model 2 predictors: CE + CK + UE + UK
SFB Model 3 predictors: UK
TB Model 1 predictors: CE + CK
TB Model 2 predictors: CE + CK + UE + UK
TB Model 3 predictors: CE + UK

**Path Diagram**

Based on the results from correlation analysis and multiple regression analysis, path diagrams were created for the SFB sample and the TB sample, respectively (Figure 10 and Figure 11). Overall, the university education variables had more direct and significant impact on the CNS and the NEP than the childhood education variables. The experience variables had stronger correlations with the CNS than the knowledge variables, while the knowledge variables had stronger correlations with the NEP than the experience variables.

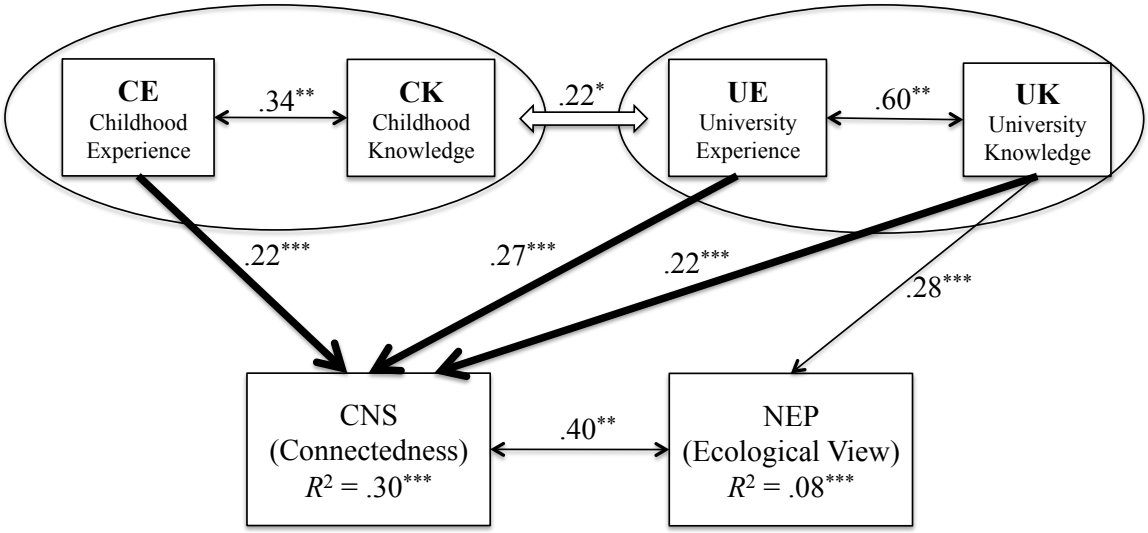


Figure 10. Path diagram showing the relationships between the environmental education and environmental attitude variables (San Francisco Bay Area). Values represent standardized coefficients. ***Significant at p < .001. **Significant at p < .01. *Significant at p < .05. Bold arrows are used when $R^2$ > .15. Average coefficient is used for showing the correlation between CE/ CK and UE/ UK (bold white arrow).

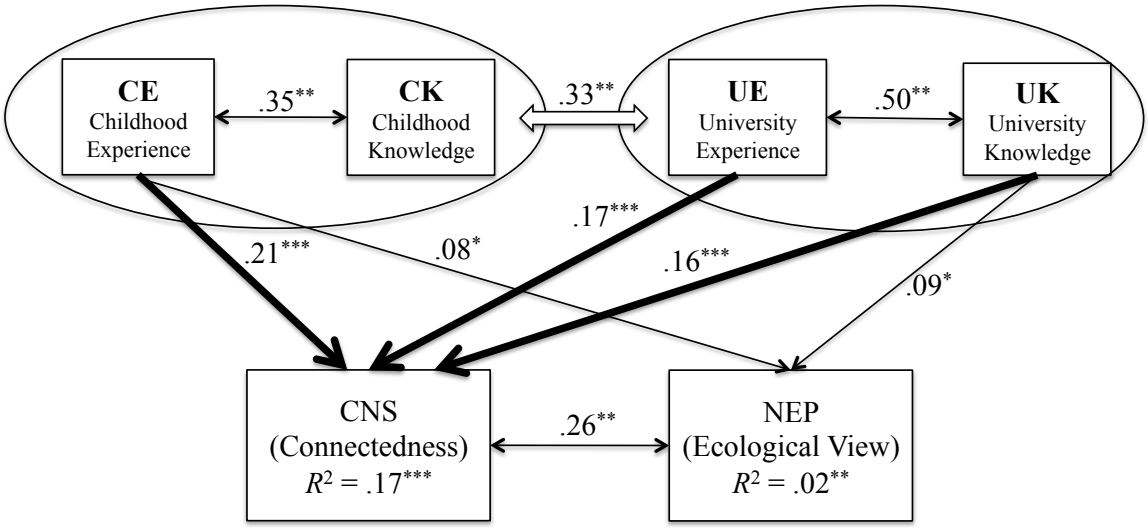


Figure 11. Path diagram showing the relationships between the environmental education and environmental attitude variables (Tokyo Bay Area). Values represent standardized coefficients. ***Significant at p < .001. **Significant at p < .01. *Significant at p < .05. Bold arrows are used when $R^2$ > .15. Average coefficient is used for showing the correlation between CE/ CK and UE/ UK (bold white arrow).

## Influence of Academic and Demographic Variables on Environmental Education

### University Environmental Education

Students majoring environmental-related subjects scored much higher in the UE and the UK than non-environmental-major students in both regions (Mann-Whitney *U* test, $p < .001$, Table 10). The difference between environmental and other majors was higher in the San Francisco Bay Area than in the Tokyo Bay Area (Figure 12).

Table 10. Comparison of the UE and the UK scores between environmental and other majors for both SFB and TB samples

| | | Environmental[a] | | Other[b] | | Mann-Whitney *U* Test | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Variable | *M* | *SD* | *M* | *SD* | *z* | *N* | *p* |
| SFB | UE | 3.56 | 1.04 | 2.44 | 0.99 | -10.15 | 457 | .000*** |
| | UK | 4.84 | 0.87 | 3.44 | 1.22 | -11.58 | 459 | .000*** |
| TB | UE | 2.62 | 0.88 | 2.03 | 0.71 | -9.23 | 774 | .000*** |
| | UK | 3.46 | 1.10 | 2.53 | 1.00 | -10.55 | 773 | .000*** |

*Notes:* ***Significant at $p < .001$. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. UE: University Experience. UK: University Knowledge.
[a]Environmental-major includes Environmental Studies, Environmental Science, Biology, Environmental/ Biology Education.
[b]All non-environmental-related subjects.

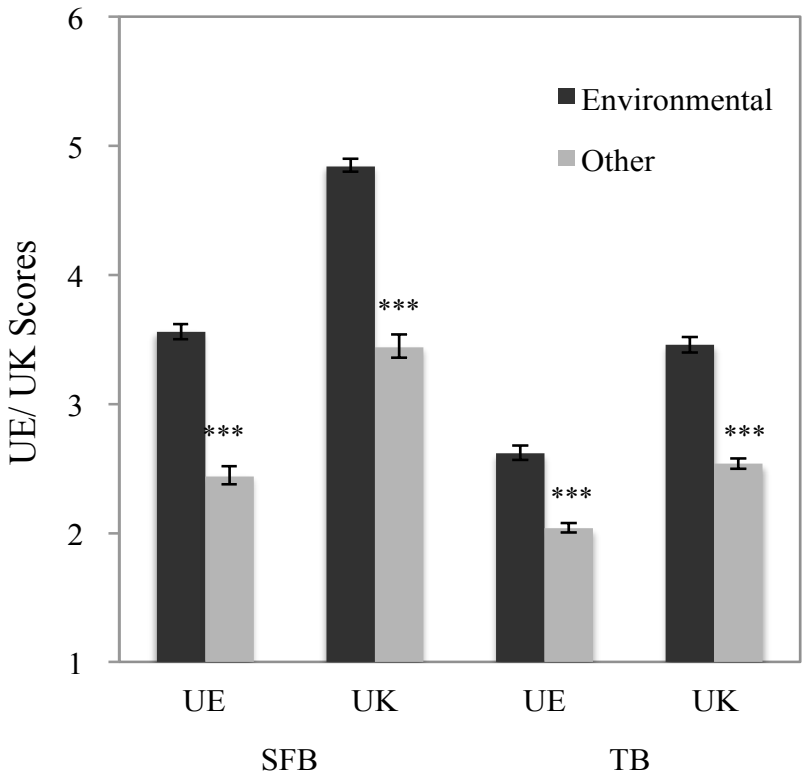


Figure 12. Comparison of the university experience (UE) and the university knowledge (UK) scores between environmental and other majors. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. Standard errors are represented in the figure by the error bars attached to each column. ***Significant at $p < .001$.

Year in university also influenced the UE/ UK scores (Table 11 and Figure 13). In environmental-related majors, upper division students scored higher than lower division students in both regions (Mann-Whitney *U* test, $p = .044$ for SFB-UE, $p < .001$ for other samples). The increase of UE/ UK scores from lower to upper division was higher in the Tokyo Bay Area. On the other hand, in non-environmental-related majors, no significant influence of year was detected in the UK scores at $p < .05$. Upper division students even yielded lower UE scores in the SFB (Mann-Whitney *U* test, $p = .037$).

Table 11. Comparison of the UE and the UK scores between lower and upper division students for both SFB and TB samples (results are shown separately based on Major)

| | | Lower[c] | | Upper[d] | | Mann-Whitney *U* Test | | |
|---|---|---|---|---|---|---|---|---|
| Sample | Variable | *M* | *SD* | *M* | *SD* | *z* | *N* | *p* |
| SFB (Environ[a]) | UE | 3.32 | 0.91 | 3.61 | 1.01 | -2.02 | 288 | .044* |
| | UK | 4.46 | 0.77 | 4.93 | 0.87 | -4.01 | 289 | .000*** |
| TB (Environ[a]) | UE | 2.40 | 0.86 | 2.80 | 0.86 | -3.69 | 277 | .000*** |
| | UK | 2.98 | 0.92 | 3.83 | 1.09 | -6.23 | 276 | .000*** |
| SFB (Other[b]) | UE | 2.74 | 1.07 | 2.38 | 0.97 | -2.09 | 164 | .037* |
| | UK | 3.55 | 1.09 | 3.45 | 1.25 | -0.64 | 165 | .522 |
| TB (Other[b]) | UE | 1.94 | 0.70 | 2.12 | 0.71 | -2.97 | 492 | .003** |
| | UK | 2.43 | 0.97 | 2.62 | 1.03 | -1.90 | 294 | .057 |

*Notes:* ***Significant at $p < .001$. **Significant at $p < .01$. *Significant at $p < .05$.
SFB: San Francisco Bay Area. TB: Tokyo Bay Area. UE: University Experience. UK: University Knowledge.
[a]Environmental major includes Environmental Studies, Environmental Science, Biology, Environmental/ Biology Education.
[b]All non-environmental related subjects.
[c]Lower division refers to the freshman- and sophomore-standing in the university.
[d]Upper division refers to the junior- and senior-standing in the university.

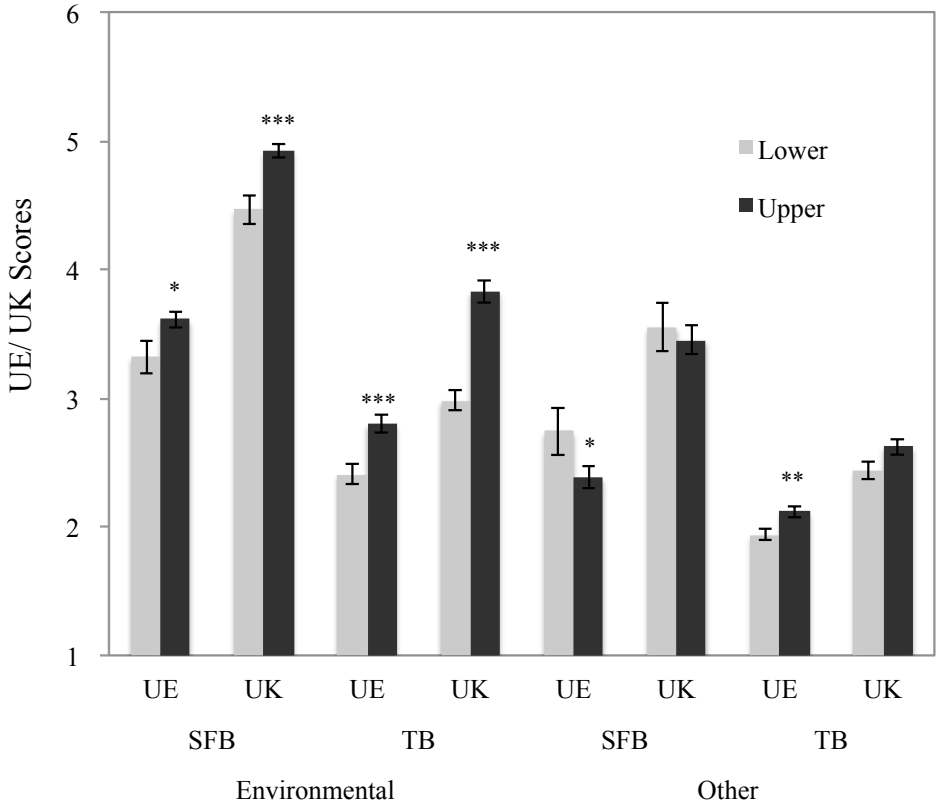


Figure 13. Comparison of the university experience (UE) and the university knowledge (UK) scores between lower and upper divisions. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. Environmental: environmental-related majors. Other: non-environmental-related majors. Standard errors are represented in the figure by the error bars attached to each column. ***Significant at $p < .001$.

When comparing the UE/ UK scores between universities, only the upper division students in environmental-related majors (those who had the highest average UE/ UK scores in the respective universities) were analyzed to have more homogeneous samples. The lowest sample size was $n = 19$ for Yokohama National University and the highest one was $n = 106$ for UCSC. Both UE and UK scores differed significantly among universities (UE: $\chi^2 = 112.04$, $df = 5$, $p < .001$; UK: $\chi^2 = 109.01$, $df = 5$, $p < .001$). As for the university experience, UCSC ($M = 4.12$, $SD = 0.86$) had the highest average UE score

followed by Santa Clara University ($M$ = 3.39, $SD$ = 1.05) and San José State University ($M$ = 3.07, $SD$ = 1.03). The three universities in the Tokyo Bay Area had lower scores than those in the SFB, with the highest score in Soka University ($M$ = 2.84, $SD$ = 0.87), followed by Saitama ($M$ = 2.55, $SD$ = 0.83) and Yokohama National University ($M$ = 2.47, $SD$ = 0.68) (Figure 14).

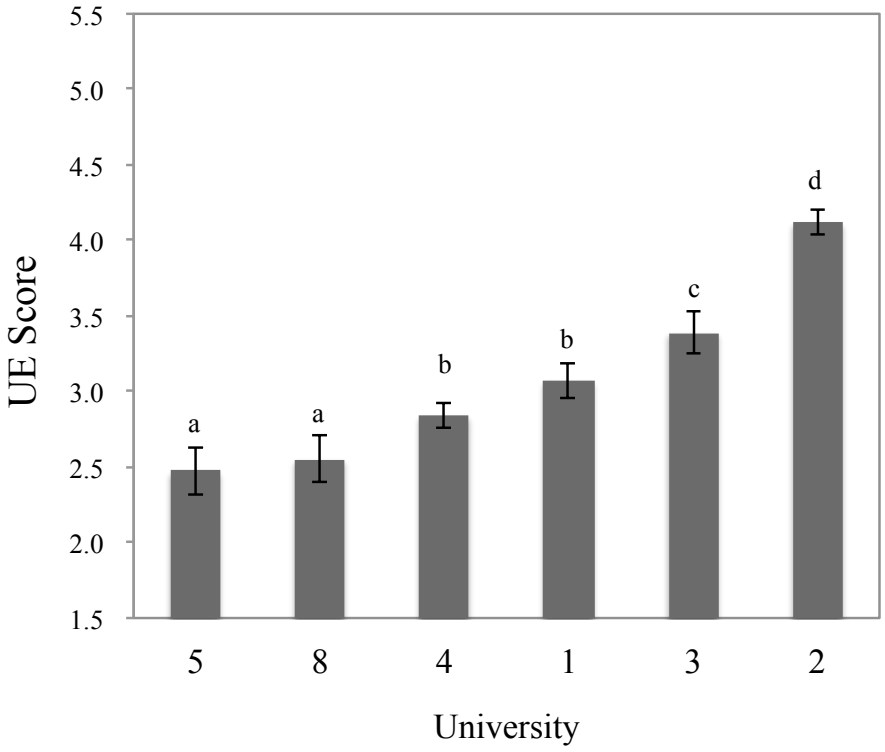


Figure 14. Comparison of the university experience (UE) scores among the different universities. 5 Yokohama National University ($n$ = 19). 8 Saitama University ($n$ = 29). 4 Soka University ($n$ = 99). 1 San José State University ($n$ = 76). 3 Santa Clara University ($n$ = 58). 2 UC, Santa Cruz ($n$ = 106). Standard errors are represented in the figure by the error bars attached to each column. Kruskal-Wallis test ($\chi^2$ = 112.04, $df$ = 5, $p$ < .001). [abcd]Grouping is based on the Dunnett's T3 post hoc test ($p$ < .05).

Similar results were yielded for the university knowledge. This time, all three universities in the SFB had close average UK scores; still, the post hoc test revealed that UCSC ($M$ = 5.01, $SD$ = 0.08) was higher than the other two universities ($M$ = 4.88, $SD$ = 0.11 for SCU; $M$ =4.82, $SD$ = 0.11 for SJSU). Soka University ($M$ = 4.14, $SD$ =0.10) had the highest UK score in the TB, followed by Saitama ($M$ = 3.24, $SD$ = 0.17) and Yokohama National University ($M$ = 2.98, $SD$ = 0.21) (Figure 15).

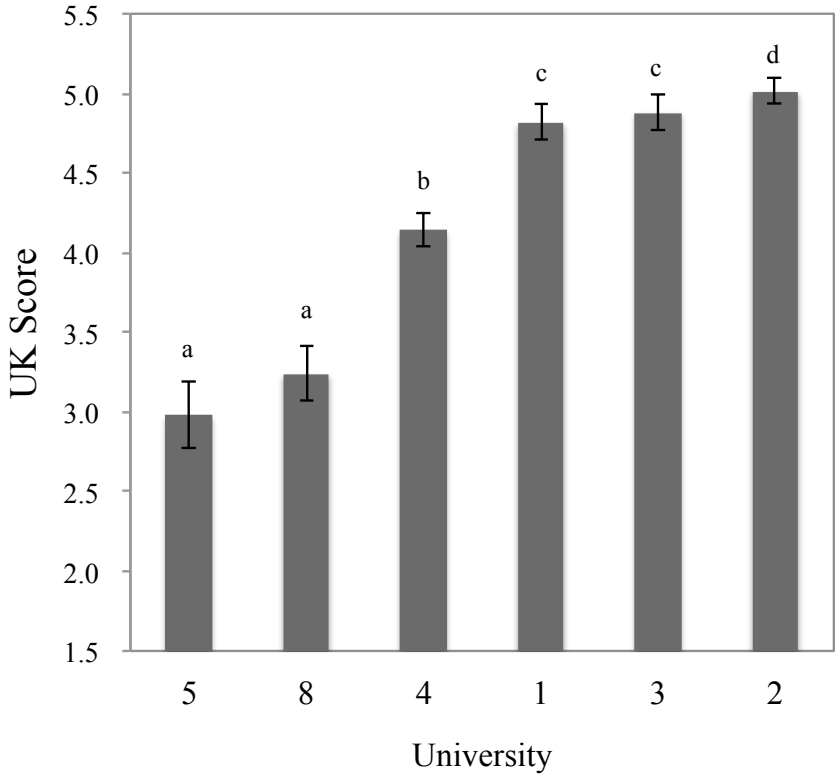


Figure 15. Comparison of the university knowledge (UK) scores among the different universities. 5 Yokohama National University ($n$ = 19). 8 Saitama University ($n$ = 29). 4 Soka University ($n$ = 99). 1 San José State University ($n$ = 76). 3 Santa Clara University ($n$ = 58). 2 UC, Santa Cruz ($n$ = 106). Standard errors are represented in the figure by the error bars attached to each column. Kruskal-Wallis test ($\chi^2$ = 109.01, $df$ = 5, $p$ < .001). [abcd]Grouping is based on the Dunnett's T3 post hoc test ($p$ < .05).

**Childhood Environmental Education**

The influence of parents' education level on students' childhood education was examined. As for the SFB sample, significant influence of parents' education level ($\chi^2$ = 15.41, $df$ = 2, $p$ < .001) was detected on the childhood experience only. The average CE score was highest ($M$ = 4.01, $SD$ = 0.92) when parents had a Masters' or PhD degree, followed by 2-4 year college graduates ($M$ = 3.89, $SD$ = 0.89; no significant difference was detected between these two groups based on the post hoc test) and then with high school certificates or less ($M$ = 3.51, $SD$ = 0.91). Childhood knowledge was not influenced by parents' education level ($p$ = .054). As for the TB sample, neither childhood experience nor knowledge was influenced by parents' education level ($p$ = .407 for CE; $p$ = .086 for CK).

In addition, when the influence of annual family income on the students' childhood education was examined, childhood experience scores significantly differed among different income levels for both SFB ($\chi^2$ = 10.40, $df$ = 4, $p$ = .034) and TB ($\chi^2$ = 10.25, $df$ = 4, $p$ = .036) samples. However, lower income did not necessarily associate with the lower CE scores, or vice versa (Figure 16 and Figure 17). Childhood knowledge did not significantly differ among different income levels in both regions (SFB: $\chi^2$ = 7.52, $df$ = 4, $p$ = .111; TB: $\chi^2$ = 4.35, $df$ = 4, $p$ = .360).

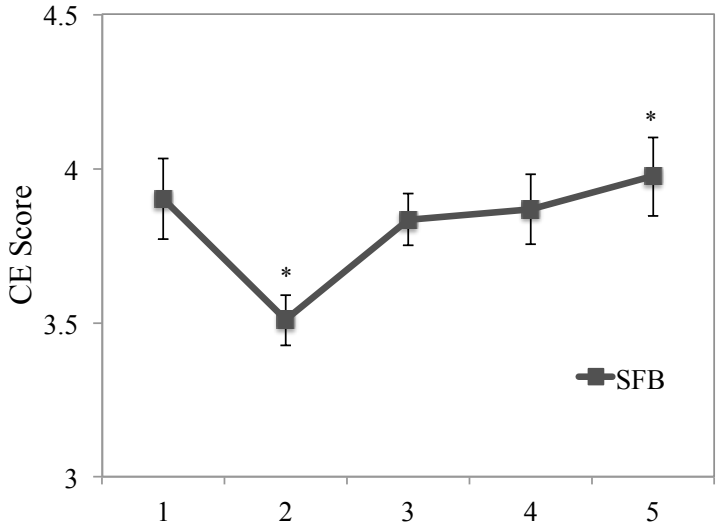


Figure 16. Comparison of the childhood experience (CE) scores among the different annual family income groups in the SFB (San Francisco Bay Area) sample. 1 < $24,999 ($n$ = 67). 2 < $49,999 ($n$ = 57). 3 < $74,999 ($n$ = 64). 4 < $99,999 ($n$ = 65). 5 > $100,000 ($n$ = 154). Standard errors are represented in the figure by the error bars attached to each column. Kruskal-Wallis test ($\chi^2$ = 10.40, $df$ = 4, $p$ = .034). Significant difference was found between group 2 and 5 by the Dunnett's T3 post hoc test ($p$ < .05).

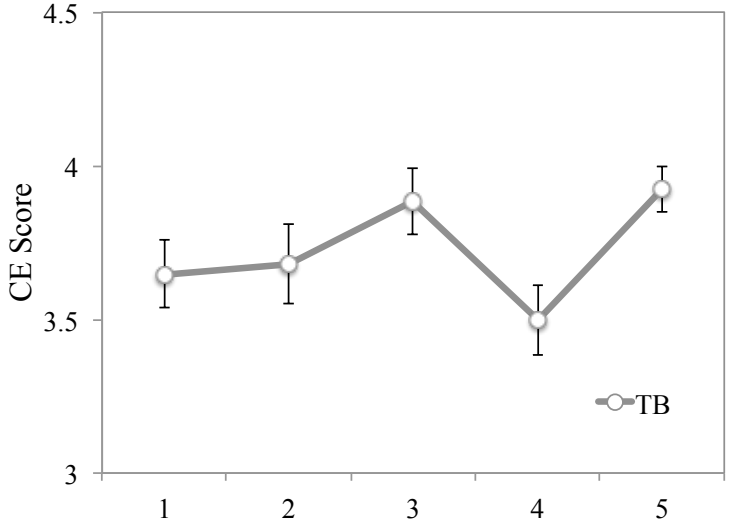


Figure 17. Comparison of the childhood experience (CE) scores among the different annual family income groups in the TB (Tokyo Bay Area) sample. 1 < $24,999 ($n$ = 45). 2 < $49,999 ($n$ = 109). 3 < $74,999 ($n$ = 102). 4 < $99,999 ($n$ = 57). 5 > $100,000 ($n$ = 49). Standard errors are represented in the figure by the error bars attached to each column. Kruskal-Wallis test ($\chi^2$ = 10.25, $df$ = 4, $p$ = .036). Group difference was not detected by the Dunnett's T3 post hoc test at $p$ < .05.

When comparing the CE/ CK scores between the two countries, students only from environmental-related majors (who are more interested in nature in general) were analyzed in order to have more homogeneous samples. Students in the San Francisco Bay Area had higher average CE score ($M = 3.92$, $SD = 0.90$) than those in the Tokyo Bay Area ($M = 3.57$, $SD = 0.84$) (Mann-Whitney $U$ test, $z = -4.98$, $N = 578$, $p < .001$). The CK score was also higher in the SFB sample ($M = 3.91$, $SD = 1.09$) than the TB sample ($M = 3.46$, $SD = 0.87$) (Mann-Whitney $U$ test, $z = -5.63$, $N = 578$, $p < .001$) (Figure 18).

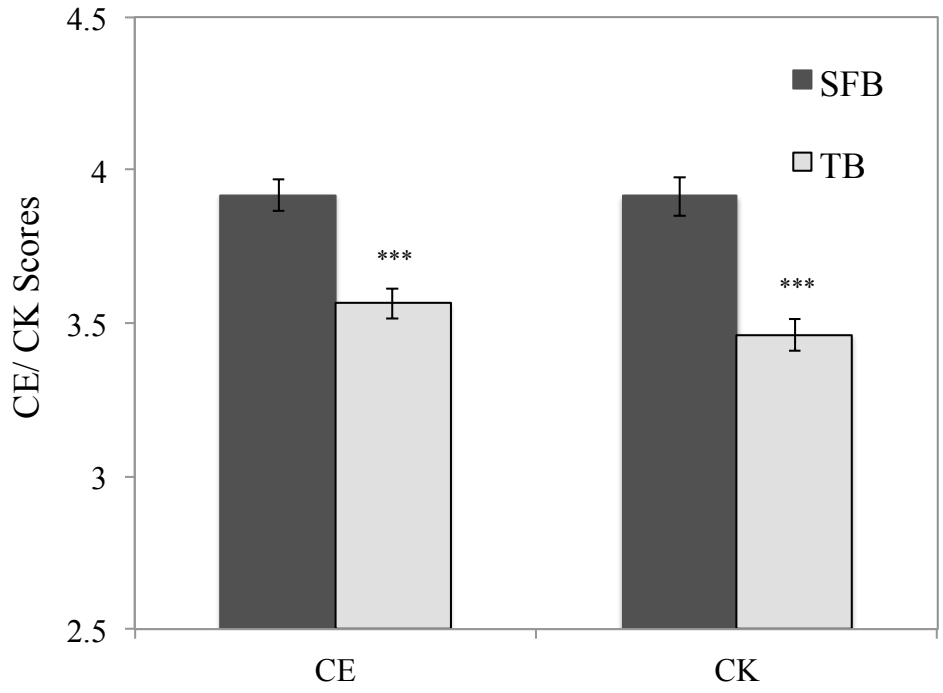


Figure 18. Comparison of the childhood experience (CE) and the childhood knowledge (CK) scores between the San Francisco Bay Area (SFB) and the Tokyo Bay Area (TB). Standard errors are represented in the figure by the error bars attached to each column. ***Significant at $p < .001$.

## Influence of Demographic Variables on Environmental Attitudes

### Religious Influence

The SFB sample was compared among Buddhist, Christian, and None-religious students. Both CNS ($\chi^2 = 6.37$, $df = 2$, $p = .041$) and NEP ($\chi^2 = 8.66$, $df = 2$, $p = .013$) scores significantly differed among the three groups, where non-religious students ($M = 4.59$, $SD = 0.96$ for CNS; $M = 5.19$, $SD = 0.75$ for NEP) had relatively higher CNS/ NEP scores than Christian students ($M = 4.35$, $SD = 0.99$ for CNS; $M = 4.94$, $SD = 0.83$ for NEP; Figure 19). The TB sample was compared between Buddhist and None-religious students. Contrary to the SFB sample, religion had no significant effect on the CNS ($z = -0.38$, $N = 363$, $p = .701$) and the NEP ($z = -1.50$, $N = 360$, $p = .133$).

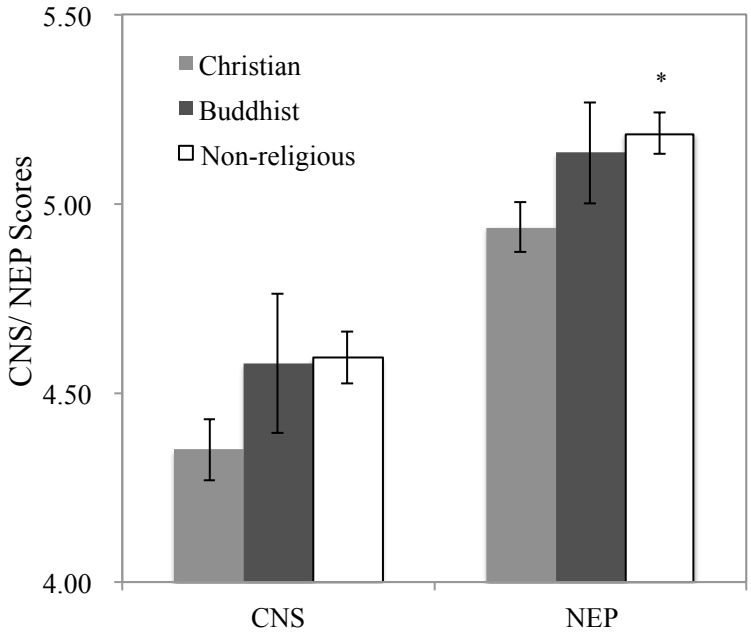


Figure 19. Comparison of the CNS and the NEP scores among the different religious groups in the San Francisco Bay Area. Christian ($n = 153$). Buddhist ($n = 39$). Non-religious ($n = 198$). Standard errors are represented in the figure by the error bars attached to each column. Significant group difference was found only between Christian and Non-religious groups on the NEP by the Dunnett's T3 post hoc test ($p < .05$).

**Gender Influence**

Significant difference ($z$ = -3.02, $N$ = 725, $p$ = .003) was found only on the CNS in the Tokyo Bay Area, where the female students ($M$ =3.76, $SD$ = 0.90) scored higher than the male students ($M$ =3.55, $SD$ = 0.95). Gender difference was not detected on the CNS ($p$ = .759) and the NEP ($p$ = .716) for the SFB sample, or on the NEP ($p$ = .992) for the TB sample.

**Country Influence**

When comparing the CNS/ NEP scores between the two countries, only the upper division students in environmental-related major (those who are supposed to have the highest average CNS/ NEP scores in the respective samples) were analyzed. Significant difference ($z$ = -8.27, $N$ = 381, $p$ < .001) was found on the CNS scores, where students in the SFB ($M$ =4.70, $SD$ = 0.93) scored higher than those in the TB ($M$ =3.83, $SD$ = 0.93). Similar results were found on the NEP scores ($z$ = -7.18, $N$ = 383, $p$ < .001), where students in the SFB ($M$ =5.17, $SD$ = 0.72) scored higher than those in the TB ($M$ =4.52, $SD$ = 0.89) (Figure 20).

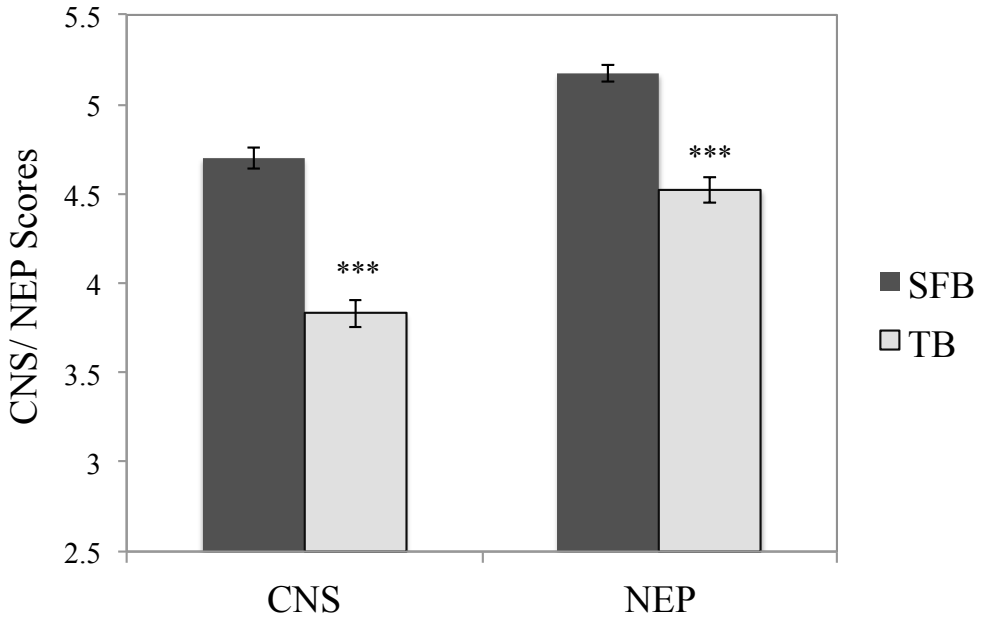


Figure 20. Comparison of the CNS and the NEP scores between the San Francisco Bay Area (SFB) and the Tokyo Bay Area (TB). Standard errors are represented in the figure by the error bars attached to each column. ***Significant at $p < .001$.

**Demographic Variables vs. Environmental Education Variables**

The relative importance of religion on the CNS and the NEP was analyzed using the SFB sample (Table 12). Regarding the CNS, the model 1 (predictors: CE, UE, and UK) explained about 28% variance in the CNS, adjusted $R^2 = .284$, $F(3, 416) = 56.31$, $p < .001$. Religion was left as the significant predictor ($b = .092$, $p = .027$) in the model 2; however, it only explained additional 0.6% variance in the CNS, adjusted $R^2 = .290$, $F(4, 415) = 43.86$, $p < .001$. Regarding the NEP, only a small variance (8%) was explained by the UK variable in the model 1, adjusted $R^2 = .079$, $F(1, 421) = 36.97$, $p < .001$. The

model 2 slightly increased an adjusted $R^2$ to .084 ($p < .001$). Religion was not a significant predictor in this model ($b = .085$, $p = .069$).

The relative importance of gender on the CNS was analyzed using the TB sample (Table 12). The three predictors in the model 1 (CE, UE, and UK) accounted for about 16% variance in the CNS, adjusted $R^2 = .163$, $F(3, 720) = 47.94$, $p < .001$. Gender was left as the significant predictor ($b = .097$, $p = .004$) in the model 2; however, it only explained additional 0.8% variance in the CNS, adjusted $R^2 = .171$, $F(4, 719) = 38.36$, $p < .001$.

Table 12. Comparison of the two sequential regression models for predicting the CNS and the NEP (influence of religion and gender)

| | SFB (San Francisco Bay Area) | | SFB (San Francisco Bay Area) | | TB (Tokyo Bay Area) | |
|---|---|---|---|---|---|---|
| | CNS | | NEP | | CNS | |
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| | *b* | *b* | *b* | *b* | *b* | *b* |
| CE | .211*** | .205*** | | | .210*** | .202*** |
| UE | .258*** | .247*** | | | .164*** | .160*** |
| UK | .218*** | .222*** | .284*** | .282*** | .167*** | .173*** |
| Religion | | .092* | | .085 | | . |
| Gender | | | | | | 097** |
| *df1* | 3 | 4 | 1 | 2 | 3 | 4 |
| *df2* | 416 | 415 | 421 | 420 | 720 | 719 |
| *F* | 56.31*** | 43.86*** | 36.97*** | 20.25*** | 47.94*** | 38.36*** |
| *r* | .537 | .545 | .284 | .297 | .408 | .419 |
| $R^2$ | .289 | .297 | .081 | .088 | .166 | .176 |
| Adjusted $R^2$ | .284 | .290 | .079 | .084 | .163 | .171 |

*Notes:* ***Significant at $p < .001$. **Significant at $p < .01$. *Significant at $p < .05$.
CE: Childhood Experience. UE: University Experience. UK: University Knowledge.
Religion: Christian was coded as 1, Buddhist was coded as 2, and non-religious affiliation was coded as 3. Gender: Male was coded as 0 and female was coded as 1.
SFB (CNS) Model 1 predictors: CE +UE + UK
SFB (CNS) Model 2 predictors: CE + UE + UK + Religion
SFB (NEP) Model 1 predictors: UK
SFB (NEP) Model 2 predictors: UK + Religion
TB (CNS) Model 1 predictors: CE +UE + UK
TB (CNS) Model 2 predictors: CE + UE + UK + Gender

Finally, the relative importance of country on the CNS and the NEP was analyzed using all the respondents' data (Table 13). The model 2 (predictors: CE, UE, and UK) explained about 32% variance in the CNS, adjusted $R^2$ = .321, $F(3, 1165) = 185.11$, $p < .001$. Country was left as the significant and important predictor ($b$ = -.204, $p < .001$) in the model 3 and it explained additional 3% variance in the CNS, adjusted $R^2$ = .350, $F(4, 1164) = 113.02$, $p < .001$. About 11% variance in the NEP was explained by the model 2 (predictors: UE and UK), adjusted $R^2$ = .111, $F(2, 1163) = 73.96$, $p < .001$. Country again was left as the significant and important predictor ($b$ = -.262, $p < .001$) in the model 3, increasing the value of adjusted $R^2$ to .160 ($p < .001$).

Table 13. Comparison of the three sequential regression models for predicting the CNS and the NEP (influence of country)

| | CNS | | | NEP | | |
|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| | *b* | *b* | *b* | *b* | *b* | *b* |
| CE | .172*** | .183*** | .192*** | .043 | | |
| CK | .034 | | | .019 | | |
| UE | .243*** | .243*** | .214*** | .079* | .095** | .060 |
| UK | .275*** | .285*** | .195*** | .260*** | .267*** | .152*** |
| Country | | | -.204*** | | | -.262*** |
| *df1* | 4 | 3 | 4 | 4 | 2 | 3 |
| *df2* | 1164 | 1165 | 1164 | 1161 | 1163 | 1162 |
| *F* | 139.30*** | 185.11*** | 113.02*** | 37.78*** | 73.96*** | 74.90*** |
| *r* | .569 | .568 | .594 | .339 | .336 | .403 |
| $R^2$ | .324 | .323 | .353 | .115 | .113 | .162 |
| Adjusted $R^2$ | .321 | .321 | .350 | .112 | .111 | .160 |

*Notes.* ***Significant at $p < .001$. **Significant at $p < .01$. *Significant at $p < .05$.
CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. Country: US was coded as 1 and Japan was coded as 2.
CNS Model 1 predictors: CE + CK + UE + UK
CNS Model 2 predictors: CE + UE + UK
CNS Model 3 predictors: CE + UE + UK + Country
NEP Model 1 predictors: CE + CK + UE + UK
NEP Model 2 predictors: UE + UK
NEP Model 3 predictors: UE + UK + Country

## Important Resources of Environmental Education

### Resources of Environmental Education (Quantitative Analysis)

The most influential factor for obtaining nature-related experience was "school" (36%) and then "family" (34%) in the SFB sample. Similarly, "school" (48%) was the most frequently selected answer in the TB sample, whose percentile was much higher than that of "family" (28%). Majority of respondents (75%) selected "school" as the most influential factor for obtaining environmental knowledge, followed by "media" (12%) in the SFB sample. The TB sample had similar results, where more students (20%) selected "media" after "school" (65%). Contrary to the nature-related experience, "family" was not a significant factor in acquiring environmental knowledge (5% and 7% for the SFB and the TB, respectively) (Table 14). Self-learning was the most common answer for those who selected "other" option.

Table 14. The most influential factor for obtaining nature-related experience and environmental knowledge for the SFB and TB samples and their total data (ALL)

| Sample | Experience Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | Family (%) | Friends (%) | School (%) | Organization (%) | | Other (%) | Multiple (%) |
| SFB | 149 (34.3) | 71 (16.3) | **155 (35.6)** | 38 (8.7) | - | 15 (3.4) | 7 (1.6) |
| TB | 197 (27.5) | 99 (13.8) | **346 (48.3)** | 51 (7.1) | - | 18 (2.5) | 6 (0.8) |
| ALL | 346 (30.0) | 170 (14.8) | **501 (43.5)** | 89 (7.7) | - | 33 (2.9) | 13 (1.1) |

| Sample | Knowledge Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | Family (%) | Friends (%) | School (%) | Organization (%) | Media (%) | Other (%) | Multiple (%) |
| SFB | 21 (4.8) | 8 (1.8) | **325 (74.9)** | 18 (4.1) | 52 (12.0) | 2 (0.5) | 8 (1.8) |
| TB | 46 (6.5) | 24 (3.4) | **461 (64.7)** | 30 (4.2) | 145 (20.3) | 3 (0.4) | 4 (0.6) |
| ALL | 67 (5.8) | 32 (2.8) | **786 (68.5)** | 48 (4.2) | 197 (17.2) | 5 (0.4) | 12 (1.0) |

*Notes:* SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB. Mode is written in bold type. Respondents who selected several choices are categorized in Multiple.

**Resources of Environmental Education (Qualitative Analysis)**

*Nature-related experience*

Participants provided (in their own words) their most memorable experiences in nature that strongly influenced their attitudes toward the natural environment (Table 15).

Table 15. Category list of the most memorable nature experience that influenced participants' attitudes toward nature (% mention rate)

| Category | SFB (*n* = 347) | TB (*n* = 275) |
|---|---|---|
| Activity | **265**[a] | **199**[a] |
| Recreational Activity | 86 | 79 |
| Camping | 27 | 17 |
| Hiking (Mountain/ Forest) | 28 | 20 |
| River/ Lake/ Ocean | 13 | 14 |
| Fishing/ Hunting | 3 | 3 |
| Interaction with animals | 9 | 13 |
| Exploring neighborhood | 6 | 14 |
| Learning Activity | 14 | 21 |
| Research/ Fieldwork/ Internship | 8 | 9 |
| Gardening/ Farming | 6 | 11 |
| Museum/ Aquarium/ Zoo | 0.4 | 2 |
| Environment | **45**[a] | **32**[a] |
| Separation from daily lives (Wilderness) | 71 | 34 |
| Nature in daily lives (Surroundings) | 29 | 66 |
| Feeling toward nature | **112**[a] | **58**[a] |
| Beauty | 27 | 12 |
| Connection/ Love | 28 | 5 |
| Wonder/ Vastness | 13 | 16 |
| Sad (Witnessing negative human impact) | 26 | 21 |
| Fear | 6 | 47 |
| Age | **350**[a] | **263**[a] |
| < 6 (Kindergarten/ 1st grade) | 13 | 14 |
| 7 to 11 (2nd to 5th grade) | 31 | 50 |
| 12 to 17 (Middle school to high school) | 23 | 17 |
| > 18 (College and university) | 25 | 14 |
| Every time (No particular age) | 9 | 5 |

*Notes:* Percentiles are calculated separately for each major category; activity, environment, feeling toward nature, and age.
[a]Frequency of citation (not in a percentile).
Some participants provided more than one citation for a particular category.
SFB: San Francisco Bay Area. TB: Tokyo Bay Area.

The memorable experiences included recreational activities such as camping and hiking as well as more learning-based activities such as fieldwork and farming. Many respondents in the San Francisco Bay Area shared that going to camping or hiking with their family and friends shaped their positive attitudes toward nature. They referred many state and national parks including Big Basin Redwoods State Park and Yosemite National Park in California. Respondents in the Tokyo Bay Area also shared their experience of hiking and camping, but not often mentioning a particular locale. More than twenty respondents in the Tokyo Bay Area referred to a farming experience in rice fields as the most memorable experience in nature.

Some respondents answered that being separated from their daily lives and immersed in wild nature had a huge impact on their lives. For example, one respondent from the San Francisco Bay Area wrote:

> I traveled to Costa Rica when I was 15 and was immersed in a natural environment different from anything I'd seen growing up in the Northeast. The biodiversity was amazing, and the connection that the people living there had with their surrounding was inspiring. Just being in the jungle and seeing all that was there showed me how vast and beautiful our natural world is (19-years-old, female).

Another respondent from the Tokyo Bay Area wrote:

> When I visited the Philippines this year, I was so amazed by the magnificent scenery of the forests, which was very different from what I've seen in Japan (19-years-old, female).

On the other hand, many students mentioned the importance of the environment of where they live. Several students from UC, Santa Cruz wrote that moving to UCSC

campus "has strongly impacted (their) attitudes toward the natural environment" because "the school is in the vicinity of a forest." Students in the Tokyo Bay Area more frequently cited their everyday experiences in the nature in their neighborhood. Several students appreciated that their school (from elementary school to university) had a lot of trees and small plants where they were able to play and relax.

Having various kinds of experiences in nature allowed students to develop some special feelings toward nature. "Connection" was one of the most cited feelings in the SFB sample.

> My first outdoor education field trip occurred in the fifth grade at the age of 10. The first event that was organized for us was a night hike. Traversing the forests in pitch-black darkness was quite frightening at first, but eventually my senses adapted to the point where I felt I was hyper-aware of even the tiniest sound and scent around me and I felt a true connection to nature around me for the first time. It was something I had never experienced before in urban areas, even in city parks (20-years-old, male).

"Vastness" and "beauty" of nature were the other frequently cited feelings in both regions.

> When I was 17-years-old, I went to Mt. Aso in Kyusyu for a school trip. I felt the great strength and power of the nature, seeing the big caldera of the mountain (21-years-old, male, Tokyo Bay Area).

> One night, when I was 16, I was walking along the beach when there were millions of stars in the blue/ purple sky. I was completely alone and entirely immersed into the beauty of my surroundings. It made me realized how small I was in the midst of this massive universe (18-years-old, female, San Francisco Bay Area).

Sad feelings caused by negative experiences were also frequently mentioned in both regions. Students witnessed negative human impacts on nature such as water

pollution, air pollution, litters on roads and beaches, urbanization, and clear cutting. Those experiences made them "to think about the environmental problems more seriously." As many as twenty-four respondents from the Tokyo Bay Area referred to the Great East Japan Earthquake in 2011, as a source of "fear," saying that "people were powerless in front of nature."

Childhood from 7- to 11-years-old was the time when many students had the memorable nature-related experiences (30% for the SFB and 50% for the TB). In the San Francisco Bay Area, the middle to high school period (12- to 17-years-old; 23%) and university period (after 18-years-old; 25%) were also cited many times, whereas they were cited much less frequently than childhood in the Tokyo Bay Area (Figure 21).

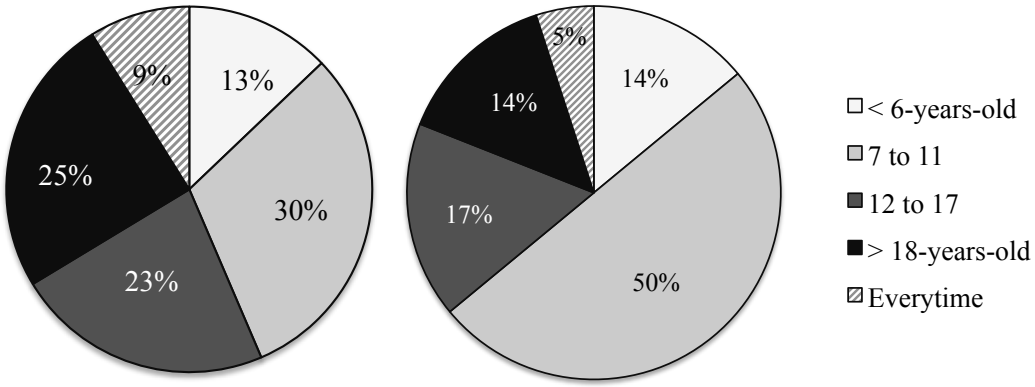


Figure 21. The timing when the most memorable nature experience occurred (% mention rate). Left chart: San Francisco Bay Area ($n$ = 350). Right chart: Tokyo Bay Area ($n$ = 263).

*Environmental knowledge*

Respondents provided (in their own words) their most memorable learning experiences that strongly influenced their attitudes toward nature (Table 16).

Table 16. Category list of the most memorable learning experience that influenced participants' attitudes toward nature (% mention rate)

| Category | SFB (*n* = 312) | TB (*n* = 233) |
|---|---|---|
| Lecture | **169**[a] | **115**[a] |
| Environmental Studies | 56 | 61 |
| General (Intro) | 11 | 8 |
| Environmental issues/ Human impact | 20 | 33 |
| Sustainability | 5 | 1 |
| Garbage/ Recycling | 7 | 6 |
| Energy/ Natural resources | 1 | 4 |
| Food/ Agriculture/ Health | 6 | 2 |
| Ecotourism | 2 | 0 |
| Ethics/ Philosophy | 4 | 7 |
| Biology | 17 | 10 |
| Ecology | 9 | 9 |
| Geology | 3 | 2 |
| Geography | 3 | 4 |
| Sociology | 2 | 1 |
| Law/ Politics | 7 | 7 |
| Economics | 2 | 4 |
| Engineering/ Chemistry | 1 | 1 |
| Literature/ Culture | 1 | 2 |
| Special Activity | **126**[a] | **79**[a] |
| High school advanced placement | 19 | 0 |
| Fieldwork | 26 | 14 |
| Camp | 13 | 18 |
| Experiment | 10 | 27 |
| Individual/ Group research | 0 | 24 |
| Interaction with teachers and elders | 14 | 9 |
| Museum/ Aquarium | 2 | 6 |
| Internships | 17 | 3 |
| Social Media | **31**[a] | **45**[a] |
| Documentary | 58 | 49 |
| Books | 36 | 29 |
| News | 7 | 22 |
| Age | **265**[a] | **119**[a] |
| < 6 (Kindergarten/ 1st Grade) | 2 | 1 |
| 7 to 11 (Elementary: 2nd to 5th Grade) | 13 | 26 |
| 12 to 17 (Middle school to high school) | 24 | 32 |
| > 18 (College and university) | 60 | 41 |
| Every time (no particular age) | 1 | 0 |

*Notes:* Percentiles are calculated separately for each major category; lecture, special activity, social media, and age.

[a]Frequency of citation (not in a percentile).

Some participants provided more than one citation for a particular category.

SFB: San Francisco Bay Area. TB: Tokyo Bay Area.

Many respondents wrote about the lectures on Environmental Studies, especially at university level, that focus on environmental issues, sustainability, environmental ethics and so on. Various other subjects (e.g., biology, ecology, geography, politics, economics, sociology) were also cited by the students in both regions. Some examples of the responses are as follows:

> I learned about various environmental issues in the Intro to Environmental Problems course when I was 18. I started to think about how I can contribute to protect the environment after taking that class (22-years-old, male, Tokyo Bay Area).

> I took Environmental Philosophy course when I was 19. I realized that human's philosophy influences the politics, thereby significantly influence the environment. I became more interested in the relationship between politics and environment and started reading books on environmental philosophy (22-years-old, female, Tokyo Bay Area).

> One significant learning experience occurred when I was a sophomore at the age of 19, taking my first ecology course. I was astonished by all of the complex interactions between animal and plant species. Never in my life had I truly considered the communities that were living in nature (21-years-old, male, San Francisco Bay Area).

Respondents also shared what they learned from experience-based learning activities such as fieldwork, summer camps, and scientific experiment. Students found that experience-based learning were far more "interesting" and "enjoyable" and that it "helped to connect what I (they) learned from the text book and the real world." As for other unique activities, high school advanced placement (AP) classes were often cited in the San Francisco Bay Area. Several students wrote that they "decided to study this subject in college" because of the AP class. In the Tokyo Bay Area, on the other hand,

individual/ group research was often cited as an important learning experience. Several students stated that they "realized the seriousness of today's environmental issues for the first time" after they conducted their individual research.

Interaction with teachers and elders were also mentioned by many students as an influential learning experience. Some examples are as follows:

> I was in the sixth grade so I was 10 and my teacher took those of us who couldn't afford to go to sixth grade camp, and taught us about nature and how to be ecological. I immediately made recycling, limiting use of electricity. I still do to this day thanks to his inspiration and passion (36-years-old, male, San Francisco Bay Area).

> Two classes that I took in junior year (age 16) to senior year (age 17), Earth Sciences led to AP Environmental Science…the teachers taught about nature in such an enthusiastic and passionate way and I felt like I was passionate too (18-years-old, male, San Francisco Bay Area).

As for the social media, documentary seemed very influential on environmental attitudes in both regions. A student from the Tokyo Bay Area wrote:

> I watched a movie titled "Earth" when I was a junior high school student. I was very shocked to see the polar bears having difficulties on getting their foods because more and more ices were melting. I couldn't understand why they (the polar bears) have to be threatened even though they have done nothing wrong to the environment (21-years-old, female).

Books such as Al Gore's "An Inconvenient Truth" and Rachel Carson's "Silent Spring" were also mentioned several times.

Contrary to the nature-related experience, most of the students had the memorable learning experiences during university period (after 18-years-old). In both regions,

middle to high school period (12- to 17-years-old) was the second influential time, followed by childhood (7- to 11-years-old; Figure 22).

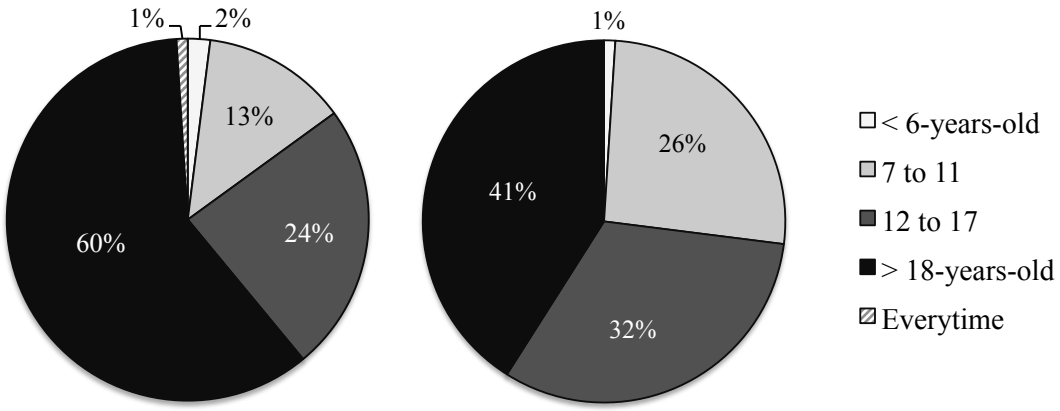


Figure 22. The timing when the most memorable learning experience occurred (% mention rate). Left chart: San Francisco Bay Area ($n$ = 265). Right chart: Tokyo Bay Area ($n$ = 119).

# DISCUSSION

## Findings of This Study

The main purpose of this study was to find out how the two basic approaches to environmental education (knowledge-based and experience-based) during childhood and university periods influence students' environmental attitudes. A total of 1,266 students from 10 universities in the San Francisco Bay Area (SFB) and the Tokyo Bay Area (TB) were surveyed in order to answer this question.

Based on correlation analysis, it was found that all the four educational variables (childhood experience (CE), childhood knowledge (CK), university experience (UE), and university knowledge (UK)) were significantly correlated with the students' sense of connectedness to nature (CNS) and ecological worldview (NEP); however, sequential regression analysis revealed that only a few of these variables were directly correlated with each other. With regard to the CNS, the CE, UE, and UK were the significant predictors and university education as a whole showed more strong correlation with the CNS than childhood education. Similarly, university education was more strongly correlated with the NEP than childhood education.

These findings contradict the research hypothesis $H_{1\text{-}1}$: the childhood variables would correlate more strongly with the CNS and the NEP than the university variables. Interestingly, even in the open-ended questions, many respondents mentioned that their learning experiences in college such as lectures and fieldworks strongly influenced their attitudes toward nature. In general, childhood is believed to be the most important time for developing values. For example, many environmentalists chose their career because

of their childhood experiences (Chawla 1999; Sward 1999). Perhaps, childhood experiences direct what students do and learn in college, thereby indirectly influence their values and beliefs even after they enter college. The moderate correlations between the childhood education variables and the university education variables found in this study support this idea. A majority of respondents also shared that their childhood nature-related experiences were the strong influential factors of their environmental attitudes. Therefore, we can say that although childhood education, especially nature-related experiences, are important for the formation of environmental attitudes, the university period may not be too late to develop students' positive attitudes toward nature.

Another way to look at this result is that "current" experience (what they do and learn in "university" for university students) is very important for keeping the positive environmental attitudes developed during childhood. Previously, a study found that students' sense of connectivity with nature increased after participating in educational programs but the effects started fading in less than three months (Stern, Powell, and Ardoin 2008), suggesting that one educational program is not enough for having long-term impacts on students. Continuous learning process from childhood to young adult and adulthood may be important for helping people sustain their positive environmental attitudes. Some students mentioned that they had influential nature-related experiences throughout their lives. We should remember that environmental education targets people of all ages and not only childhood (UNESCO 1978).

Focusing on educational approaches, the experience variables had stronger correlations with the CNS, whereas the knowledge variables had stronger correlations

with the NEP. This finding was in accord with the research hypotheses $H_{1\text{-}2}$: the experience variables would correlate more strongly with the CNS than the NEP and $H_{1\text{-}3}$: the knowledge variables would correlate more strongly with the NEP than the CNS. It might be natural that students who have more nature-related experiences would feel more connected with nature. In fact, many students used the word "connection" when they were writing about their nature-related experiences in the open-ended question. Previous studies also found that people who spent more time outdoors scored higher in the CNS (Mayer and Frantz 2008) and showed stronger emotional affinity toward nature (Palmberg and Kuru 2000). Because the NEP is a more cognitive-based measure that asks the human-nature relationship in general, getting higher NEP scores may require more environmental knowledge (rather than just having outdoor experiences).

Contrary to the strong correlation between education variables and the CNS, the education variables were able to explain only a small fraction in the NEP. One possible reason for this is that the NEP did not function well as the measure of environmental beliefs in this study. The frequency distribution graphs showed that the NEP data were highly skewed to the extreme positive side in both SFB and TB samples. The NEP scale was originally developed in the late 1970s as a reaction to the social paradigm shift in the U.S. at that time, where people started to realize that human actions were significantly damaging the environment (Dunlap and Van Liere 1978). This idea, however, may have become a fact that most people agree with, at least those who have taken higher education. For example, 79% of respondents (Washington residents) agreed to the statement "humans are severely abusing the environment" in 1976 (Dunlap et al. 2000), while 87%

of the respondents in this study agreed to the statement. We might need a new measure of environmental beliefs that can cover a wide range of participants' ideas for the future studies.

Continuing the discussion on educational approaches, experience-based learning may be more important than knowledge-based learning. According to the value-belief-norm theory, personal values are the precedent factors of general beliefs of the environment (Stern et al. 1995). In this study, a strong correlation was found between the education and the CNS (indicator of environmental values) and between the CNS and the NEP (general beliefs). This result suggests that education may indirectly affects the NEP through the CNS. Taking this "indirect influence" into consideration, nature-related experiences are more important than environmental knowledge for fostering students' environmental attitudes because they were the strong predictors of the CNS.

More than a century ago, progressive educators such as John Dewey (1959) in the U.S. or Tsunesaburo Makiguchi (1971) in Japan warned the lack of children's direct experience in the local environment. Place-based environmental education, which includes outdoor educational approaches (Woodhouse and Knapp 2000), has been increasingly recognized since the 1990s (Stevenson et al. 2013). Despite its increased recognition and efforts to implement "education *in* the environment;" however, education in formal school systems is still dominated by knowledge-based learning. Moreover, the time spent outdoors by young people are rapidly decreasing in the developed countries because of the increased access to electronic devices (Zaradic and Pergams 2007). Students have less opportunity of direct experiences in nature than ever. In this study,

several students mentioned that the fieldworks and experiments after the classroom lectures enhanced their learning experiences. Many students cited summer camps as unforgettable learning experiences. We should implement more experience-based learning in both formal and informal educational settings.

As for the influence of academic backgrounds, environmental-related major students had higher average UE/ UK scores than non-environmental-related major students, supporting the research hypothesis $H_{2\text{-}1}$. Upper division students also scored higher in the UE/ UK than lower division students (supporting $H_{2\text{-}2}$), but this pattern was found only in the environmental-related major. These results suggest that students in environmental-related-major accumulate their knowledge and experiences related to the environment throughout their academic careers. This accumulation of knowledge and experience may explain why environmental-related-major students generally have more positive environmental attitudes as found in previous studies (Tikka, Kuitunen, and Tynys 2000). Interestingly, lectures from various academic fields, including geology, sociology, politics, and even literature, were referred as influential learning experiences. There is a potential for improving environmental education even outside of environmental-related majors. The influential power of introductory level courses, as previously suggested by McMillan, Wright, and Beazley (2004), was also supported in this study.

The comparison of the UE/ UK scores among universities revealed that UCSC students had the highest average scores in the SFB sample, while Soka University students had the highest average scores in the TB sample. Both UCSC and Soka

University have the largest campus size in the respective regions and located in a suburban (forest) area. Other four universities included in the analysis are all located in an urban area. This difference in campus environment might have caused the difference in the UE/ UK scores. In fact, several students from UCSC wrote that they enjoyed the nature on campus everyday and that the campus environment influenced their attitudes toward nature. When students feel more empathy toward nature, they are more likely to acquire knowledge about the local flora and fauna (Hammond and Herron 2012). By having more nature-related experiences in daily campus-life (higher UE), UCSC and Soka University students might have been motivated to learn more about the environment (higher UK).

Children's educational experiences can be greatly influenced by their family income, which usually correlated with parents' highest education level. For example, the majority of academic achievement gaps between low-income and high-income students, in the U.S., can be explained by the unequal access to the summer study programs (Alexander, Entwisle, and Olson 2007). In Japan, students with higher family income are more likely to go to private schools and have more learning opportunities even outside of schools (Ministry of Internal Affairs and Communications 2014). Based on these facts, students with higher family income and higher parents' educational backgrounds were expected to have higher CE/ CK scores ($H_{3\text{-}1}$ and $H_{3\text{-}2}$). Contrary to the hypotheses, higher income did not result in higher experience or knowledge scores. As for parents' highest education level, students whose parents had associate degrees (or higher) slightly scored higher in the childhood experience variable than students whose parents had high

school diploma (or less) in the SFB sample, but significant difference was not found in the TB sample. These results suggest that parents' economic and academic status may not be as important with regards to their children's environmental education. This might have happened because all participants in this study were university students, most of which are generally from relatively high-income, high educational proportions of the entire population.

The second major aim of this study was to find out how the social and cultural backgrounds of students influence their environmental attitudes. The scores of the CNS and the NEP variables were compared among different gender and religious groups. The significant influence of religion was found only in the SFB sample, between non-religious students and Christian students, where non-religious students had higher average scores in both CNS and NEP. Since White (1967) suggested the negative influence of the Judeo-Christian beliefs on environmental attitudes, various studies have been conducted to investigate the influence of religion (especially Christian traditions in the U.S.) on environmentalism. Some studies have found that religious traditions such as conservative eschatology negatively affected environmental attitudes (Guth et al. 1995), supporting the result from this study. The relationship between religion and environmentalism, however, are very complex and there are many contradicting data (Harper 2008; Horenstein 2012). It might be better not to make conclusions based on the limited data from this study, which only asked participants religious affiliation but not measured their degree of faith or participation in religious activities. Significant difference was not found between Buddhist and Christian students as was expected ($H_{4\text{-}1}$:

students who believe in Buddhism would have higher average CNS/ NEP scores than students who believe in Christianity) mainly due to the large standard errors caused by the small Buddhist sample size.

In Japan, female students had higher average CNS scores than male students. Gender difference was not significant on the NEP scores or in the SFB sample, so $H_{4\text{-}2}$: female students would have higher average CNS/ NEP scores than male students, was only partially supported. In other studies, females were found to have more positive attitude towards the environment (Muller, Kals, Pansa 2009; Tikka, Kuitunen, and Tynys 2000). Contrary to the contradicting arguments on religious impacts, the impacts of gender have been consistently supported across ages and countries, where females have generally shown more positive environmental attitudes and behavior (Zelezny, Chua, and Aldrich 2000). It is interesting, therefore, that gender difference was found only in the CNS for the TB sample. The fact that women have more and more equal opportunities in various activities as men, especially in the U.S., might explain why gender difference was not so significant among the participants in this study.

Overall, the influence of education was much stronger than that of social/ cultural backgrounds (in this case, religion and gender) over the environmental attitudes. The sequential regression analysis revealed that religion and gender explained less than 1% additional variance in the CNS and the NEP after controlling education variables. This finding is very important because it proves that education has a power to change students' environmental attitudes regardless of their backgrounds. The present study was focused only in the two developed regions in the U.S. and Japan, but the positive power of

environmental education has been reported from many regions across the world (Stevenson et al. 2013).

Finally, the scores of education variables and attitude variables were compared between the SFB sample and the TB sample. The students studying in the universities in the SFB had higher average UE/ UK and CE/ CK scores than those studying in the universities in the TB. This result supports the hypotheses $H_{2\text{-}3}$: students in American universities would have higher average UE/ UK scores than those in Japanese universities and $H_{3\text{-}3}$: students in the San Francisco Bay Area would have higher average CE/ CK scores than those in the Tokyo Bay Area. As discussed in the Literature Review section, environmental education is more widely implemented in the American school systems and the SFB has more natural habitats compared to the TB. In fact, many respondents from the SFB stated that they enjoy camping, hiking, kayaking etc. in the various state and national parks. Those parks provide visitors many interpretive programs (California Department of Parks and Recreation 2014), which is often lacking in Japan. These facts may have reflected in the difference of the CE/ CK and UE/ UK scores between the SFB and the TB samples.

Interestingly, even after controlling the educational variables, "country" had significant influences on students' environmental attitudes, where students in the U.S. held more positive environmental attitudes than students in Japan. This finding contradicted the hypothesis $H_{4\text{-}3}$: students in the Tokyo Bay Area would have higher average CNS/ NEP scores than those in the San Francisco Bay Area. The country variable explained additional 3% variance in the CNS and 5% variance in the NEP,

suggesting that its influence is bigger than religion or gender but still smaller than education.

We have to be very careful, however, when comparing scores between different countries. It is well known that people from different cultures or societies respond differently to the questionnaire items regardless of the contents (Baumgartner and Steenkamp 2001). Harzing (2006) found that Japanese people tended to choose "middle response" (i.e., answer 3 in the 5-point Likert-type questions), whereas American people tended to choose "extreme positive response" (i.e., answer 5 in the 5-point Likert-type questions). This pattern was also reported in other studies (Shiomi and Loo 1999; Takahahshi et al 2002). Based on these findings, we can expect that American students would have higher average scores on Likert-type questions than Japanese students.

Furthermore, both CNS and NEP were originally developed in the U.S., reflecting its historical context. Although careful translation was conducted by three researchers in this study, some words were unfamiliar in Japan and were difficult to translate. Scale anchors (such as sometimes, often, almost always) may not have metric equivalence in different languages (Harzing 2006). Considering all these factors, the difference of the CE/CK, UE/ UK, and CNS/ NEP scores between the SFB sample and TB sample might have just reflected the different response style and language, and not reflected the true difference of education and attitude's level.

One of the positive results from this study was that the efforts of implementing environmental education in these two regions are reflected in the students' voices. School was selected as the most important factor for having nature-related experience and

obtaining environmental knowledge. Many students wrote about the high school advanced placement class (in the SFB) and individual/ group research in the Comprehensive Studies class (in the TB), which were one of the main focuses of environmental education in the respective countries. Students shared how their teachers' passion inspired them to think more about the environment. The implementation of environmental education may be slow (Kaplowitz and Levine 2005), but our efforts are bearing fruit in students' heart.

To conclude, the relationships between various variables were illustrated based on the results of this study (Figure 23).

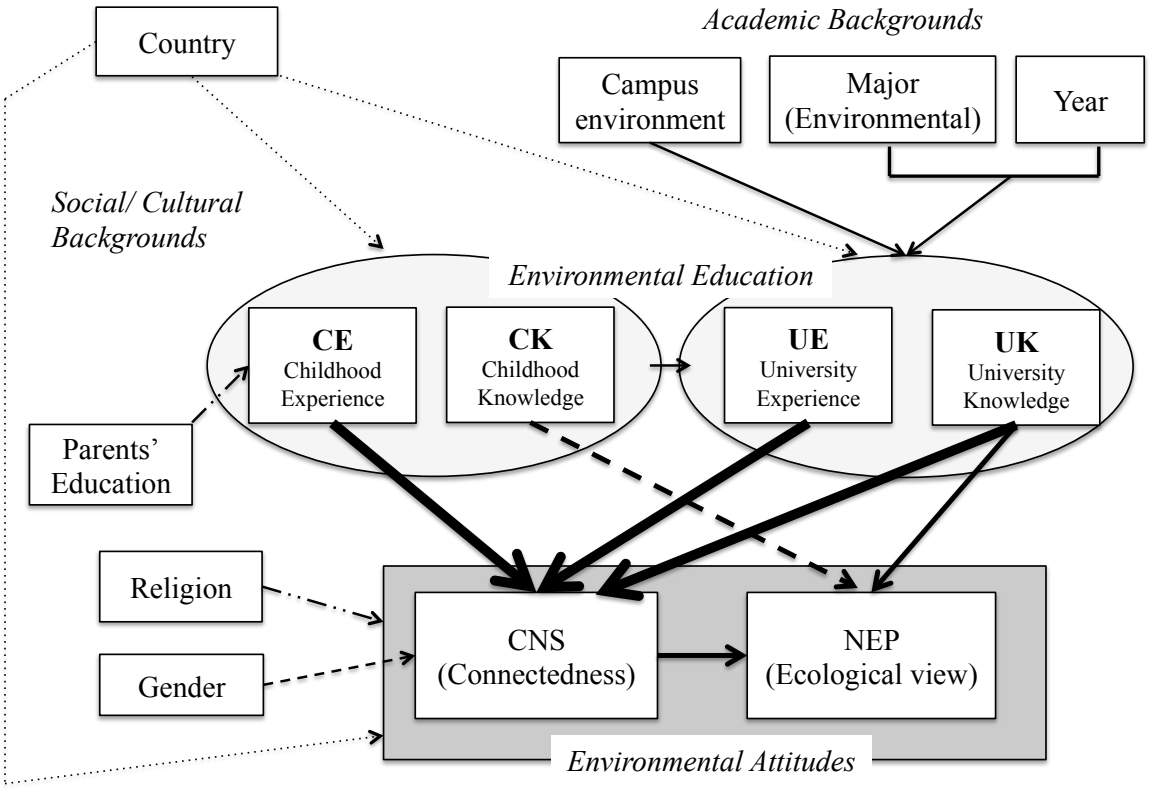


Figure 23. Summary relationships between various variables found in this study. The influence of environmental education was much stronger than that of social/ cultural backgrounds on environmental attitudes. Academic backgrounds were important during university period. The influence of country was suggested but it might have caused by a survey bias. Normal line: The relationship was found in both San Francisco Bay Area (SFB) and Tokyo Bay Area (TB). Dot line a (-..-..): The relationship was found only in the SFB sample (Parent's education-CE and Religion-CNS/ NEP). Dot line b (----): The relationship was found only in the TB sample (Gender-CNS). Dot line c (….): The relationship is questionable (Country-CE/ CK, UE/ UK, CNS/ NEP).

## Recommendations

The findings of this study indicate that environmental education at both childhood and university periods strongly influence students' environmental attitudes regardless of their social/ cultural backgrounds. The following action plans are recommended for managers and educators for future environmental education.

- Teachers, educators, and program managers should include more experience-based learning approaches to environmental education. Students' environmental attitudes are developed largely by experience but not by knowledge.
- Academic committees of universities should implement more introductory level courses on environmental topics for students of all majors. It is possible to incorporate environmental dimension into the existing academic programs outside of environmental-related major.
- School officials should create campuses where students can enjoy nature on a daily basis. Campus environment significantly influence students' environmental knowledge and experiences.
- Policy makers and program managers should emphasize the importance of lifelong learning process of environmental education. There is a need for developing educational programs for adolescents and adults.

# CONCLUSION

The role of environmental education is becoming increasingly important at this time when human actions are severely abusing the environment more than ever before. Changing environmental values and beliefs, which are the fundamental factors that shape various pro-environmental behaviors, is the key to creating a more sustainable society. This study aimed to provide a better understanding of how environmental education during younger periods in life influence the students' environmental attitudes. The results of this study suggest that university environmental education is as important as childhood environmental education and that educational influence is more powerful than social and cultural influences. The efforts of implementing environmental education in the formal school systems were reflected in the students' responses in both San Francisco Bay Area and Tokyo Bay Area; however, there is a need to include more experience-based approaches. Recommendations for future environmental education were suggested based on the results.

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APPENDIX A: INVITATION LETTER SAMPLE (ENGLISH)

## Request for Survey Participation

Dear San José State University student,

My name is Minako Nishiyama and I am a graduate student in the Department of Environmental Studies at San José State University.

As part of my Master of Science thesis research, I am investigating how childhood and university experiences affect students' attitudes toward nature.

If you have received this letter, please access the link below to complete the survey, and do not forward it. The first page will be an informed consent letter.

https://www.surveymonkey.com/s/EEUS

The time to complete the survey should be only about **10 minutes.**

The response from each one of you is very important for this research.
Please complete the survey as soon as possible, so as not to forget about it, but the final date is **Thursday, October 31, 2013.**

Thank you very much for your corporation!

**Minako Nishiyama**
Department of Environmental Studies
San José State University
Phone: 408-664-8089
Email: minako.nishiyama@sjsu.edu

APPENDIX B: INVITATION LETTER SAMPLE (JAPANESE)

アンケート調査へのご協力のお願い

東大生の皆さん

初めまして、こんにちは。カリフォルニア、サンノゼ州立大学大学院の環境学部で学んでいる西山美奈子と申します。
「子ども時代、および大学時代の体験、学習が、どのように自然に対する価値観に影響するか」というテーマで行っている研究の、アンケートへのご協力に関するお願いです。

下記のリンクにアクセスして、アンケートにご回答ください。

リンク：https://www.surveymonkey.com/s/EEJP

アンケートは、約 10 分で回答できる内容となっています。
回答期限は、2013 年 10 月 27 日（日）です。
＊できれば忘れないうちに、お早めにご回答ください。

皆さん一人ひとりの回答が、大事な研究のデータとなります。是非ご協力お願いいたします！

*なお、この情報は、第三者には公開せず、使用後は速やかに処分していただくよう、お願いいたします。*

西山美奈子 (Minako Nishiyama)
サンノゼ州立大学 (San José State University)

## APPENDIX C: QUESTIONAIIRE SAMPLE (ENGLISH)

*Environmental Education and Attitudes Toward the Natural Environment: A Survey of American and Japanese Undergraduate Students*

Dear Participant,

My name is Minako Nishiyama, and I am a graduate student at San José State University, San Jose, CA. As part of my Master's Thesis, I am conducting the following research to analyze how your childhood and university learning experiences affect your attitudes toward the natural environment.

If you choose to participate, you will be asked to answer questions about your experiences and environmental attitude. The estimated time to complete this survey is about 10 minutes.

Participating in this study should cause no foreseeable risks nor discomforts, and you will receive no direct benefits nor compensation. No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose not to participate in this study.

Your participation is entirely voluntary. You may refuse to participate in the entire study or in any part of the study. If you decide to participate in this study, you are free to withdraw at any time without any negative effect on your relations with San José State University. You have the right to not answer questions if you do not wish to answer.

Your participation will, however, helps us to better understand the impacts of environmental education on environmental attitudes.

Although the results of this study may be published, all personal information will be kept confidential.

Questions about this research should be addressed to Minako Nishiyama at minako.nishiyama@sjsu.edu (Japanese/ English). Complaints about the research should be presented to Lynne Trulio, PhD, Department of Environmental Studies at 650-740-9446 (English). Questions about a research subjects' rights, or research-related injury may be presented to Pamela Stacks, Ph.D., Associate Vice President, Graduate Studies and Research at 408-924-2427 (English).

Please keep a copy of this form for your own records. By agreeing to participate in this study, it is implied that you have read and understand the above information.

Thank you very much for your help and participation!

Minako Nishiyama
San José State University

**Section I. For the following questions, please select one answer that best describes you (check the circle or fill in the blank).**

Q.1 Gender:

◯Male ◯Female

Q.2 Age: ( )

Q.3 Name of Your University: ( )

Q.4 Your Standing in the University:

◯Sophomore ◯Junior ◯Senior ◯Other ( )

Q.5 Department (Major): ( )

**Section II. A. The following questions are about your experiences during childhood (K-12 level). For each question, please choose the most appropriate response.**

**If your life style and/or school environment changed significantly during this period, please answer the questions based on the most influential time for you.*

Answer choices for Q.6:

1 = Never/ Not at all, 2 = Once in a while/ Very little, 3 = Occasionally/ A little bit, 4 = Sometimes/ Somewhat, 5 = Frequently/ Quite a bit, 6 = Almost all the time/ A significant amount.

Q.6 When you were young (K-12):

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | How often did you paly outside? | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | How much time did you spend taking care of animals and/or plants? | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | How often did you engage in outdoor activities in natural environments? | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | How much experience did you have conducting experiments related to natural environments and/or living things? | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | How often did your school(s) offer field trips to natural environments? | 1 | 2 | 3 | 4 | 5 | 6 |

Answer choices for Q.7:

1 = Not well at all, 2 = Slightly well, 3 = Mildly well, 4 = Fairly well, 5 = Quite well, 6 = Extremely well.

Q.7 By the time you graduated from high school, how well did you understand the following topics?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | How animals and plants live. | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | How natural systems (including living and non-living things) work. | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | The causes and effects of various environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | The relationship between economic activities and environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | The relationship between politics and environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |

**Section II. B. The following questions are about your experiences since you began studying at the university. For each question, please choose the most appropriate response.**

Answer choices for Q.8:

1 = Never/ Not at all, 2 = Once in a while/ Very little, 3 = Occasionally/ A little bit, 4 = Sometimes/ Somewhat, 5 = Frequently/ Quite a bit, 6 = Almost all the time/ A significant amount.

Q.8 Since you became a university student:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | In the place(s) wher you spend most of your time, such as your university campus or your work place, how often do you experience nature? | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | How often do you engage in activities directly connected to plants and/or animals such as gardening and farming currently? | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | How often do you engage in outdoor activities in natural environments currently? | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | How many experiences conducting experiments related to natural environments and/or living things have you had since starting college? | 1 | 2 | 3 | 4 | 5 | 6 |

Q.9 In your university,

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | How many course that offer field trips to natural environments have you taken? | 0 | 1 | 2 | 3 | 4 | > 5 |

Answer choices for Q.10:

1 = Not at all, 2 = Very little, 3 = A little bit, 4 = Somewhat, 5 = Quite a bit, 6 = A significant amount.

Q.10 While studying at the university, how much knowledge have you obtained in the following topics, both inside and outside the classroom?

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Biology (i.e., study of life and living organisms). | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | Ecology (i.e., study of interaction between organisms and their environment). | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | The causes and effects of various environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | The relationship between economic activities and environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | The relationship between politics and environmental issues. | 1 | 2 | 3 | 4 | 5 | 6 |

**Section III. The following question is about your attitude towards the natural environment.**

Answer choices for Q.11:

1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Slightly agree, 5 = Agree, 6 = Strongly agree.

Q.11 For each statement, please indicate your level of agreement. As above, a higher number indicates more agreement with the statement.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | I think of the natural world as a community to which I belong. | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | I often feel disconnected from nature. | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | I often feel a kinship with animals and plants. | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | I feel as though I belong to the Earth as equally as it belongs to me. | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | My personal welfare is independent of the welfare of the natural world. | 1 | 2 | 3 | 4 | 5 | 6 |
| 6 | I often feel part of the web of life. | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | The balance of nature is strong enough to cope with the impacts of modern industrial nations. | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 8 | When humans interfere with nature it often produces disastrous consequences. | 1 | 2 | 3 | 4 | 5 | 6 |
| 9 | Human ingenuity will insure that we do not make the earth unlivable. | 1 | 2 | 3 | 4 | 5 | 6 |
| 10 | Humans are severely abusing the environment. | 1 | 2 | 3 | 4 | 5 | 6 |
| 11 | Despite our special abilities humans are still subject to the laws of nature. | 1 | 2 | 3 | 4 | 5 | 6 |
| 12 | The so-called "ecological crisis" facing humankind has been greatly exaggerated. | 1 | 2 | 3 | 4 | 5 | 6 |

**Section IV. Please answer the following questions based on your own experiences.**

Q.12 (1) Which of the following factors has been most helpful in providing you the opportunity to experience nature?

◯Family ◯Friends ◯School ◯Organizations (work, clubs, etc.)

◯Other ( )

Q.12 (2) Please describe one experience in nature that has strongly influenced your attitude towards the natural environment. *Please indicate your age when it happened.

Q.13 (1) Which of the following factors has been most helpful in acquiring environmental knowledge?

◯Family ◯Friends ◯School ◯Organizations (work, clubs, etc.)

◯Media (books, TV, etc.) ◯Other ( )

Q.13 (2) Please describe one learning experience that has strongly influenced your attitude towards the natural environment. *Please indicate your age when it happened.

**Section V. Your demographic information (Optional).**

Q.14 What religion, if any, do you most associate with?

◯Buddhism ◯Christianity ◯Hinduism

◯Islam ◯Judaism ◯None ◯Other ( )

Q.15 What is the highest level of education completed by your parents?

◯Middle school or less ◯High school

◯2-year college or equivalent ◯4-year college or equivalent

◯Graduate school (Master/PhD)

Q.16 What is the approximate average income of your household?

◯$0 - $24,999 ◯$25,000 - $49,999

◯$50,000 - $74,999 ◯$75,000 - $99,999

◯$100,000 and up

APPENDIX D: QUESTIONAIIRE SAMPLE (JAPANESE)

*環境教育と自然観：*
*日本及びアメリカの大学生の意識調査*

アンケート調査にご協力していただく皆様へ

こんにちは。カリフォルニア、サンノゼ州立大学大学院で学んでいる、西山美奈子と申します。修士論文の一環として、「子ども時代、および大学時代の体験、学習が、どのように自然に対する価値観に影響するか」というテーマで研究を行っています。

アンケートへの参加に同意していただいた場合、これまでの経験や自然観に関する質問に答えていただきます。アンケートは、約 10 分で回答できる内容となっています。

アンケート回答にともなうリスク、不快感等は生じないと思われます。 また、参加することによる直接の利益、報酬もありません。しかし、環境教育についての一般的知識 を深めるという点で、あなたの参加はとても重要です。

この研究の結果は、学術雑誌に掲載される可能性がありますが、個人情報は一切掲載されることはありません。

研究に関して何かご質問がありましたら、 私(minako.nishiyama@sjsu.edu) までご連絡ください（日本語、英語）。 研究に関する苦情は、 サンノゼ州立大学環境学部学部長、Lynne Trulio (650-740-9446)までお電話ください（英語）。研究参加者の権利等に関しましては、サンノゼ州立大学大学院研究科准副学長の Pamela Stacks (408) 924-2427 までお電話ください（英語）。

この研究に参加しないことで、あなたに不利益が発生することはありません。

研究への参加は任意です。参加を拒否することも、アンケートの回答を開始してから、途中でやめることもできます。それによってサンノゼ州立大学とあなたの関係に悪影響が出ることはありません。また、答えたくない質問は未回答でも結構です。

必要な方は、この同意書をお手元に保存して下さい。アンケートへの回答をもって、上記の内容を理解、同意していただいたとみなさせていただきます。

ご協力、大変にありがとうございます！

西山美奈子 (Minako Nishiyama)
サンノゼ州立大学 (San José State University)

**セクション1　以下の質問に対して、最もよく当てはまる回答を選んで（または枠内に書き込んで）ください。**

Q.1 性別：

○男性　　○女性

Q.2 年齢：（　　）

Q.3 大学名：（　　）

Q.4 学年：

○２年生　　○３年生　　○４年生　　○その他（　　）

Q.5 学科（専攻）：（　　）

**セクション2A　以下は、あなたの子ども時代（幼稚園～高校まで）の経験に対する質問です。それぞれの質問に対して、最もよくあてはまる回答を1つ選んでください。**

＊ *生活スタイルや学校環境がこの時期に大きく変化している場合は、あなた自身にとってより印象の強い時期を基準に答えてください。*

Q.6 の回答パターン：

１＝全くなかった／全くやらなかった、２＝まれにあった／ほとんどやらなかった、３＝時折あった／少しやっていた、４＝しばしばあった／まあまあやっていた、５＝たびたびあった／けっこうやっていた、６＝ほぼいつもあった／かなりやっていた。

Q.6 子ども時代（幼稚園～高校時代）は…

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | よく屋外で遊んでいましたか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 動物や植物（またはその両方）の世話をどれくらいしていましたか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 海や山などの自然に触れるアウトドア活動に、どれくらいの頻度で行っていましたか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 自然や生物（またはその両方）に関連した実験をどのくらい行っていましたか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | 通っていた学校で、直接自然を体験するような機会（フィールド調査、サマーキャンプ、修学旅行など）は、どれくらいありましたか？ | 1 | 2 | 3 | 4 | 5 | 6 |

Q7 の回答パターン：

１＝全然理解していなかった、２＝少ししか理解していなかった、３＝ある程度は理解していた、４＝まずまず理解していた、５＝よく理解していた、６＝かなりよく理解していた。

Q.7 高校を卒業するまでに、以下の事柄についてどの程度理解していましたか？

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 動物と植物がどのように生きているのか。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 自然環境（生物、非生物含む）がどのように機能しているか。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 様々な環境問題の原因と結果について。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 政治活動と環境問題の関連性について。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | 政治と環境問題の関連性について。 | 1 | 2 | 3 | 4 | 5 | 6 |

**セクション2B　以下は、大学時代の経験に対する質問です。それぞれの質問に対して、最もよくあてはまる回答を1つ選んでください。**

Q.8 の回答パターン：

１＝全くない、２＝まれに、３＝時折、４＝しばしば、５＝たびたび、６＝ほぼいつも。

Q.8 大学生になってから…

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 大学や職場など、一日の大半を過ごす場所では、どれくらい自然を感じますか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | ガーデニングや飼育など、動物や植物（またはその両方）と直接関わる活動に、現在どれくらいの頻度で関わっていますか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 海や山などの自然に触れるアウトドア活動に、現在どれくらいの頻度で行っていますか？ | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 自然や生物（またはその両方）に関連した実験を、現在どれくらい行っていますか？ | 1 | 2 | 3 | 4 | 5 | 6 |

Q.9 大学では…

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 自然環境に関わるフィールド調査に行く機会のある授業を、どのくらい取ったことがありますか？ | 0 | 1 | 2 | 3 | 4 | > 5 |

Q.10 の回答パターン：

１＝全く増やさなかった、２＝ほんの少ししか増やさなかった、３＝少しだが増やした、４＝まあまあ増やした、５＝けっこう増やした、６＝かなり増やした。

Q.10 大学生になってから、授業や自主学習を通して、以下の事柄についての知識をどれくらい増やしましたか？

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 生物学（生命と生物に関する学問）に関する知識。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 生態学（生物と環境の相互作用に関する学問）に関する知識。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 様々な環境問題の原因と影響に関する知識。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 経済活動と環境問題の関係性についての知識。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | 政治と環境問題の関係性についての知識。 | 1 | 2 | 3 | 4 | 5 | 6 |

**セクション3　以下は、あなたの自然環境に対する考え方に関する質問です。**

Q.11 の回答パターン：

１＝全くそう思わない、２＝そう思わない、３＝あまりそう思わない、４＝少しそう思う、５＝そう思う、６＝非常にそう思う。

Q.11 それぞれの質問に対して、最もよくあてはまる回答を１つ選んでください。

上に示したように、大きな数字ほど賛成の度合いが強いことを示しています。

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 自然界を、自分が属するコミュニティーであると思う。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 2 | 自然からの孤立感をよく感じる。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 3 | 私はよく、動植物に対して親近感を感じる。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 私は自分が地球の一部であると同様に、地球もまた自分の一部であるように感じる。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 5 | 私自身の個人的な幸福は、自然界の繁栄とは無関係である。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 6 | 私自身が生命の網（他の生物との複雑な相互関係）の一部であるとよく感じる。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 自然界には、現代の産業国がもたらす影響を十分に緩和できる、強いバランス力がそなわっている。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 8 | 人間が自然に干渉すると、たいていは破滅的な影響をもたらす。 | 1 | 2 | 3 | 4 | 5 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | 人類の発明の力があれば、地球が我々の住めない場所になることは確実に防げるだろう。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 10 | 人類は自然環境を酷使している。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 11 | 人間は他の生物が持っていない特別な能力を持っているが、それでもなお自然の法則に逆らうことはできない。 | 1 | 2 | 3 | 4 | 5 | 6 |
| 12 | 人類が直面していると言われる、いわゆる「生態系の危機」は、誇張されすぎている。 | 1 | 2 | 3 | 4 | 5 | 6 |

**セクション４　以下の質問に、あなた自身の経験をもとに答えてください。**

Q.12 (1) 次のうち、あなたが直接自然に触れ合う機会（自然体験）を得た一番の要因は何ですか？

〇家族　　〇友達　　〇学校　　〇組織　（職場、クラブ団体など）

〇その他(　　)

Q.12 (2) あなたの自然観（自然環境に対する考え方）に強く影響を与えた、自然体験を１つ書いてください。＊その体験をした時の年齢も明記してください。

Q.13 (1) 次のうち、あなたが環境に関する知識を増やす上で、最も大きな要因になったものはどれですか？

〇家族　　〇友達　　〇学校　　〇組織（職場、クラブ団体など）

〇メディア（本、テレビなど）　　〇その他 (　　)

Q.13 (2) あなたの自然観（自然環境に対する考え方）に強く影響を与えた、学習体験を１つ書いてください。＊その時の年齢も明記してください。

| |
|---|
| |

**セクション５　最後に、あなた自身のバックグラウンドについてもう少し教えて下さい（任意回答）。**

Q.14 どの宗教を信じていますか？

◯仏教　　◯キリスト教　　◯ヒンドゥー教

◯イスラム教　　◯ユダヤ教　　◯無宗教　◯その他(　　)

Q.15 あなたの父親、または母親が取得している最も高い学位はなんですか？

◯中学校以下　　◯高校またはそれに類似した専門学校

◯短大または同等レベルの専門学校　　◯大学（学士）

◯大学院（修士、博士）

Q.16 あなたの家族の平均年収はどれくらいですか？

◯250 万円未満　　◯250～499 万円

◯500～ 749 万円　　◯750 ～999 万円

◯1000 万円以上

## APPENDIX E: CODEBOOK

*Notes.* For all variables, missing data were coded as "99." Recoded variables and created indexes are shown in italics.

| Variable Name | Explanation/ Coding System | |
|---|---|---|
| QIN | Questionnaire Identification Number | |
| | U001 | Response# 1 from U.S. sample |
| | U487 | Response# 487 from U.S. sample |
| | J001 | Response# 1 from Japanese sample |
| | J840 | Response# 840 from Japanese sample |
| Gender | Gender | |
| | 0 | Male |
| | 1 | Female |
| Country | Country | |
| | 1 | U.S. |
| | 2 | Japan |
| Age | Age | |
| | No change from the input was made. | |
| *AgeR* | Recoded age variable | |
| | 1 | 18-19 |
| | 2 | 20-24 |
| | 3 | 25-29 |
| | 4 | 30s |
| | 5 | 40s & 50s |
| University | University | |
| | 1 | San José State University |
| | 2 | University of California, Santa Cruz |
| | 3 | Santa Clara University |
| | 4 | Soka University |
| | 5 | Yokohama National University |
| | 6 | The University of Tokyo |
| | 7 | Tokyo Gakugei University |
| | 8 | Saitama University |
| | 9 | Kyoei University |
| | 10 | Aoyama Gakuin University |

| | | |
|---|---|---|
| Year | Year in University | |
| | 1 | Freshmen |
| | 2 | Sophomore |
| | 3 | Junior |
| | 4 | Senior |
| | 5 | Graduate |
| *YearR* | 1 | Lower division (Year 1-2) |
| | 2 | Upper division (Year 3-5) |
| Major | Major | |
| | 1 | Environmental |
| | 2 | Biology, Chemistry |
| | 3 | Computer, Physics, Math, Engineering |
| | 4 | Education (other than environmental education) |
| | 5 | Economics |
| | 6 | Sociology, Anthropology, History |
| | 7 | Politics, Global study, Journalism |
| | 8 | Literature, Philosophy, Psychology |
| | 9 | Art (Music and Design) |
| | 10 | Undeclared |
| | 11 | Other |
| *MajorR* | Recoded Major variable | |
| | 1 | Environmental-related (Major 1-2) |
| | 2 | Other (Major 3-11) |

*Note.* For the following variables, the response pattern ranged from "1" to "6" based on a 6-point Likert-type scale.

| | |
|---|---|
| CE1 | How often did you paly outside? |
| CE2 | How much time did you spend taking care of animals and/or plants? |
| CE3 | How often did you engage in outdoor activities in natural environments? |
| CE4 | How much experience did you have conducting experiments related to natural environments and/or living things? |

| | |
|---|---|
| CE5 | How often did your school(s) offer field trips to natural environments? |
| *Childhood Experience* | (CE1 + CE2 + CE3 + CE4 + CE5) / 5 |
| CK1 | How animals and plants live. |
| CK2 | How natural systems (including living and non-living things) work. |
| CK3 | The causes and effects of various environmental issues. |
| CK4 | The relationship between economic activities and environmental issues. |
| CK5 | The relationship between politics and environmental issues. |
| *Childhood Knowledge* | (CK1 + CK2 + CK3 + CK4 + CK5) / 5 |
| UE1 | In the place(s) where you spend most of your time, such as your university campus or your work place, how often do you experience nature? |
| UE2 | How often do you engage in activities directly connected to plants and/or animals such as gardening and farming currently? |
| UE3 | How often do you engage in outdoor activities in natural environments currently? |
| UE4 | How many experiences conducting experiments related to natural environments and/or living things have you had since starting college? |
| UE5 | How many course that offer field trips to natural environments have you taken? |
| *University Experience* | (UE1 + UE2 + UE3 + UE4 + UE5) / 5 |
| UK1 | Biology (i.e., study of life and living organisms). |
| UK2 | Ecology (i.e., study of interaction between organisms and their environment). |
| UK3 | The causes and effects of various environmental issues. |

| | |
|---|---|
| UK4 | The relationship between economic activities and environmental issues. |
| UK5 | The relationship between politics and environmental issues. |
| *University Knowledge* | (UK1 + UK2 + UK3 + UK4 + UK5) / 5 |
| CNS1 | I think of the natural world as a community to which I belong. |
| CNS2 | I often feel disconnected from nature. |
| *CNS2R* | Recoded CNS2 variable<br>Scores for CNS2 variable was reversed. |
| CNS3 | I often feel a kinship with animals and plants. |
| CNS4 | I feel as though I belong to the Earth as equally as it belongs to me. |
| CNS5 | My personal welfare is independent of the welfare of the natural world. |
| *CNS5R* | Recoded CNS5 variable<br>Scores for CNS5 variable was reversed. |
| CNS6 | I often feel part of the web of life. |
| *CNS* | (CNS1 + CNS2R + CNS3 + CNS4 + CNS5R + CNS6) / 6 |
| NEP1 | The balance of nature is strong enough to cope with the impacts of modern industrial nations. |
| *NEP1R* | Recoded NEP1 variable<br>Scores for NEP1 variable was reversed. |
| NEP2 | When humans interfere with nature it often produces disastrous consequences. |
| NEP3 | Human ingenuity will insure that we do not make the earth unlivable. |
| *NEP3R* | Recoded NEP3 variable<br>Scores for NEP3 variable was reversed. |

| | |
|---|---|
| NEP4 | Humans are severely abusing the environment. |
| NEP5 | Despite our special abilities humans are still subject to the laws of nature. |
| NEP6 | The so-called "ecological crisis" facing humankind has been greatly exaggerated. |
| *NEP6R* | Recoded NEP6 variable<br>Scores for NEP6 variable was reversed. |
| *NEP* | (NEP1R + NEP2 + NEP3R + NEP4 + NEP5 + NEP6R) / 6 |
| ExpFac | Most influential experience factor<br>1 Family<br>2 Friends<br>3 School<br>4 Organizations<br>5 Other<br>6 Multiple answers |
| KnowFac | Most influential knowledge factor<br>1 Family<br>2 Friends<br>3 School<br>4 Organizations<br>5 Media<br>6 Other<br>7 Multiple answers |
| Religion | Religion<br>1 Buddhism<br>2 Christianity, Catholic<br>3 Hindu<br>4 Islam<br>5 Judaism<br>6 Other<br>7 None |
| *ReligionR* | Recoded Religion variable<br>1 Buddhism<br>2 Christianity, Catholic<br>3 Others |

| | | |
|---|---|---|
| | 4 | None |
| *ReligionTB* | Recoded Religion variable for analyzing TB sample | |
| | 1 | Buddhism |
| | 2 | None |
| | 88 | All others |
| *ReligionSFB* | Recoded Religion variable for analyzing SFB sample | |
| | 1 | Christianity, Catholic |
| | 2 | Buddhism |
| | 3 | None |
| | 88 | All others |

Table A. Academic and demographic characteristics of each university sample and their total data

| Sample | University | | | University Characteristic | | | Survey | Year | | | Major | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | RR[a] (%) | Type | Level | Campus | Type | Lower[b] (%) | Upper[c] (%) | Graduate (%) | Environ[d] (%) | Other[e] (%) |
| 1 | San Jose State University | 190 | 26.7 | Public | Teaching | Urban | Online | 5 (2.7) | 166 (89.2) | 15 (8.1) | 78 (41.3) | 111 (58.7) |
| 2 | University of California, Santa Cruz | 150 | 48.2 | Public | Research | Suburban/ Forest, Ocean | Online | 22 (14.9) | 122 (82.4) | 4 (2.7) | 125 (83.3) | 25 (16.7) |
| 3 | Santa Clara University | 130 | 32.7 | Private | Research | Urban | Online | 56 (43.1) | 74 (56.9) | 0 (0.0) | 93 (84.5) | 37 (33.6) |
| 4 | Soka University | 357 | 52.8 | Private | Middle | Suburban/ Forest | Online | 90 (25.4) | 263 (74.1) | 2 (0.6) | 103 (29.1) | 251 (70.9) |
| 5 | Yokohama National University | 110 | 100.0 | Public | High | Urban/ Ocean | Paper | 40 (38.1) | 65 (61.9) | 0 (0.0) | 37 (34.6) | 70 (65.4) |
| 6 | The University of Tokyo | 19 | 27.1 | Public | High | Urban | Online | 0 (0.0) | 18 (94.7) | 1 (5.3) | 1 (5.3) | 18 (94.7) |
| 7 | Tokyo Gakugei University | 30 | 76.9 | Public | High | Suburban | Online | 23 (76.7) | 7 (23.3) | 0 (0.0) | 29 (96.7) | 1 (3.3) |
| 8 | Saitama University | 217 | 99.5 | Public | Middle | Urban | Paper | 173 (81.6) | 38 (17.9) | 1 (0.5) | 112 (53.3) | 98 (46.7) |
| 9 | Kyoei University | 57 | 100.0 | Private | Middle | Suburban | Paper | 30 (52.6) | 27 (47.4) | 0 (0.0) | 0 (0.0) | 57 (100.0) |
| 10 | Aoyama Gakuin University | 6 | 24.0 | Private | High | Urban | Online | 0 (0.0) | 6 (100.0) | 0 (0.0) | 0 (0.0) | 6 (100.0) |
| SFB | San Francisco Bay Area (3 universities) | 470 | 33.1 | | | | | 83 (17.9) | 362 (78.0) | 19 (4.1) | 296 (63.1) | 173 (36.9) |
| TB | Tokyo Bay Area (7 universities) | 796 | 66.6 | | | | | 356 (45.4) | 424 (54.1) | 4 (0.5) | 282 (36.0) | 501 (64.0) |
| ALL | 10 Universities in SFB & TB | 1266 | 48.4 | | | | | 439 (35.2) | 786 (63.0) | 23 (1.8) | 578 (46.2) | 674 (53.2) |

[a]RR (response rate) was calculated as number of valid responses devided by number of students who received the invitation letter.
[b]Lower division refers to the freshman- and sophomore-standing in the university.
[c]Upper division refers to the junior- and senior-standing in the university.
[e]Environ: Environmental related subjects include Environmental Studies, Envrionemntal Science, Biology, Environmental/ Biology Education.
[f]Other: All non-environmental related subjects.

Table A (cont.). Academic and demographic characteristics of each university sample and their total data

| Sample | University | | Gender | | Age | | Religion | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | Male (%) | Female (%) | *M* | *SD* | Buddhist (%) | Christian (%) | Other (%) | None (%) |
| 1 | San Jose State University | 190 | 79 (42.0) | 109 (58.0) | 24.3 | 5.4 | 24 (13.9) | 65 (37.6) | 18 (10.4) | 66 (38.2) |
| 2 | University of California, Santa Cruz | 150 | 69 (46.3) | 80 (53.7) | 21.7 | 3.6 | 3 (2.2) | 23 (17.0) | 13 (9.6) | 96 (71.1) |
| 3 | Santa Clara University | 130 | 49 (38.0) | 80 (62.0) | 20.6 | 2.2 | 9 (7.6) | 67 (56.3) | 7 (5.9) | 36 (30.3) |
| 4 | Soka University | 357 | 193 (54.2) | 163 (45.8) | 20.7 | 1.1 | 303 (95.0) | 0 (0.0) | 2 (0.6) | 14 (4.4) |
| 5 | Yokohama National University | 110 | 78 (73.6) | 28 (26.4) | 20.6 | 1.5 | - | - | - | - |
| 6 | The University of Tokyo | 19 | 17 (89.5) | 2 (10.5) | 22.3 | 1.0 | 5 (27.8) | 0 (0.0) | 1 (5.6) | 12 (66.7) |
| 7 | Tokyo Gakugei University | 30 | 15 (51.7) | 14 (48.3) | 20.7 | 1.6 | 5 (17.2) | 1 (3.4) | 1 (3.4) | 22 (75.9) |
| 8 | Saitama University | 217 | 129 (60.3) | 85 (39.7) | 19.7 | 1.3 | - | - | - | - |
| 9 | Kyoei University | 57 | 32 (57.1) | 24 (42.9) | 19.7 | 1.2 | - | - | - | - |
| 10 | Aoyama Gakuin University | 6 | 0 (0.0) | 6 (100) | 21.2 | 0.8 | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (100.0) |
| SFB | San Francisco Bay Area (3 universities) | 470 | 197 (41.9) | 269 (57.7) | 22.4 | 4.4 | 36 (8.4) | 155 (36.3) | 38 (8.9) | 198 (46.4) |
| TB | Tokyo Bay Area (7 universities) | 796 | 464 (58.3) | 322 (40.5) | 20.4 | 1.4 | 313 (84.1) | 1 (0.3) | 4 (1.1) | 54 (14.50) |
| ALL | 10 Universities in SFB & TB | 1266 | 661 (52.8) | 591 (46.7) | 21.2 | 3.1 | 349 (43.7) | 156 (19.5) | 42 (5.3) | 252 (31.5) |

| Sample | Parents Education | | | Annual Family Income (%) | | | | |
|---|---|---|---|---|---|---|---|---|
| | ~High School[g] (%) | ~Bachelor[h] (%) | ~PhD[i] (%) | ~$24,999 | ~$49,999 | ~$74,999 | ~$99,999 | >$100,000 |
| 1 | 50 (28.7) | 93 (53.4) | 31 (17.8) | 41 (25.0) | 30 (18.3) | 30 (18.3) | 19 (11.6) | 44 (26.8) |
| 2 | 22 (16.2) | 76 (55.9) | 38 (27.9) | 21 (16.2) | 14 (9.3) | 24 (16.0) | 22 (14.7) | 49 (32.7) |
| 3 | 12 (10.2) | 50 (42.4) | 56 (47.5) | 5 (4.4) | 13 (11.5) | 10 (8.8) | 24 (21.2) | 61 (54.0) |
| 4 | 103 (31.8) | 207 (63.9) | 14 (4.3) | 43 (13.8) | 97 (27.2) | 86 (24.1) | 49 (13.7) | 36 (10.1) |
| 5 | - | - | - | - | - | - | - | - |
| 6 | 1 (5.6) | 14 (77.8) | 3 (16.7) | 0 (0.0) | 1 (5.3) | 5 (26.3) | 3 (15.8) | 9 (47.4) |
| 7 | 11 (37.9) | 17 (58.6) | 1 (3.4) | 2 (6.7) | 11 (36.7) | 10 (33.3) | 3 (10.0) | 2 (6.7) |
| 8 | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | - |
| 10 | 0 (0.0) | 4 (66.7) | 2 (33.3) | 0 (0.0) | 0 (0.0) | 1 (16.7) | 2 (33.3) | 2 (33.3) |
| SFB | 84 (19.6) | 219 (51.2) | 125 (29.2) | 67 (16.5) | 57 (14.0) | 64 (15.7) | 65 (16.0) | 154 (32.8) |
| TB | 115 (30.5) | 242 (64.2) | 20 (5.3) | 45 (12.4) | 109 (30.1) | 102 (28.2) | 57 (15.7) | 49 (13.5) |
| ALL | 199 (24.7) | 461 (57.3) | 145 (18.0) | 112 (14.6) | 166 (13.1) | 166 (13.1) | 122 (9.6) | 203 (16.0) |

[g]Graduated from middle school, high school or less.

[h]Graduated from 2-year college or 4-year university.

[i]Obtained Master's degree or PhD degree.

Table B1. Mean scores and standard deviations of the items of the environmental education and attitude variables. Data are shown by each university sample.

| Variables/ Items | San José State ($n$ = 190) | | UC, Santa Cruz ($n$ = 150) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| **CE** | **3.66** | **0.89** | **3.96** | **0.97** |
| CE1 | 4.82 | 1.17 | 5.13 | 0.96 |
| CE2 | 3.46 | 1.51 | 3.95 | 1.38 |
| CE3 | 4.01 | 1.28 | 4.33 | 1.31 |
| CE4 | 2.85 | 1.27 | 3.09 | 1.30 |
| CE5 | 3.16 | 1.24 | 3.31 | 1.20 |
| **CK** | **3.76** | **1.14** | **4.02** | **1.08** |
| CK1 | 4.39 | 1.13 | 4.57 | 1.19 |
| CK2 | 4.17 | 1.19 | 4.44 | 1.18 |
| CK3 | 3.85 | 1.32 | 4.15 | 1.24 |
| CK4 | 3.33 | 1.49 | 3.52 | 1.42 |
| CK5 | 3.08 | 1.58 | 3.43 | 1.46 |
| **UE** | **2.53** | **1.03** | **3.87** | **1.00** |
| UE1 | 3.27 | 1.34 | 5.10 | 1.07 |
| UE2 | 2.41 | 1.34 | 3.65 | 1.50 |
| UE3 | 3.15 | 1.41 | 4.35 | 1.20 |
| UE4 | 2.58 | 1.36 | 3.78 | 1.43 |
| UE5 | 1.24 | 1.49 | 2.48 | 1.80 |
| **UK** | **3.95** | **1.32** | **4.69** | **1.06** |
| UK1 | 3.88 | 1.58 | 4.49 | 1.44 |
| UK2 | 3.39 | 1.69 | 4.88 | 1.31 |
| UK3 | 4.21 | 1.58 | 5.01 | 1.12 |
| UK4 | 4.18 | 1.53 | 4.61 | 1.31 |
| UK5 | 4.08 | 1.62 | 4.48 | 1.44 |
| **CNS** | **4.34** | **1.07** | **4.74** | **0.90** |
| CNS1 | 4.87 | 1.27 | 5.27 | 0.88 |
| CNS3 | 4.19 | 1.47 | 4.74 | 1.24 |
| CNS4 | 4.33 | 1.43 | 4.66 | 1.37 |
| CNS6 | 3.99 | 1.38 | 4.29 | 1.26 |
| **NEP** | **5.11** | **0.81** | **5.23** | **0.70** |
| NEP2 | 4.86 | 1.12 | 2.65 | 1.24 |
| NEP4 | 5.26 | 1.07 | 5.46 | 0.87 |
| NEP5 | 5.19 | 0.97 | 5.57 | 0.81 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.

Table B1 (cont.). Mean scores and standard deviations of the items of the environmental education and attitude variables. Data are shown by each university sample.

| Variables/ Items | Santa Clara ($n$ = 130) | | Soka ($n$ = 357) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| **CE** | **3.96** | **0.87** | **3.72** | **0.86** |
| CE1 | 4.96 | 1.02 | 4.64 | 1.26 |
| CE2 | 3.82 | 1.35 | 3.73 | 1.36 |
| CE3 | 4.30 | 1.19 | 3.57 | 1.29 |
| CE4 | 3.22 | 1.19 | 2.98 | 1.20 |
| CE5 | 3.48 | 1.16 | 3.70 | 1.15 |
| **CK** | **4.14** | **0.95** | **3.42** | **0.93** |
| CK1 | 4.77 | 1.02 | 3.97 | 1.17 |
| CK2 | 4.61 | 1.05 | 3.71 | 1.17 |
| CK3 | 4.28 | 1.19 | 3.78 | 1.17 |
| CK4 | 3.65 | 1.27 | 2.96 | 1.26 |
| CK5 | 3.41 | 1.26 | 2.67 | 1.17 |
| **UE** | **3.21** | **1.01** | **2.32** | **0.82** |
| UE1 | 3.69 | 1.15 | 4.00 | 1.39 |
| UE2 | 2.84 | 1.44 | 2.19 | 1.44 |
| UE3 | 3.68 | 1.24 | 2.44 | 1.17 |
| UE4 | 3.62 | 1.45 | 2.21 | 1.52 |
| UE5 | 2.21 | 1.63 | 0.74 | 1.15 |
| **UK** | **4.45** | **1.08** | **3.01** | **1.27** |
| UK1 | 4.01 | 1.68 | 2.89 | 1.66 |
| UK2 | 4.40 | 1.41 | 2.72 | 1.60 |
| UK3 | 4.88 | 1.22 | 3.40 | 1.49 |
| UK4 | 4.56 | 1.35 | 3.16 | 1.51 |
| UK5 | 4.40 | 1.48 | 2.89 | 1.44 |
| **CNS** | **4.54** | **0.91** | **3.75** | **1.03** |
| CNS1 | 5.12 | 1.06 | 4.24 | 1.30 |
| CNS3 | 4.52 | 1.24 | 3.80 | 1.34 |
| CNS4 | 4.27 | 1.38 | 3.43 | 1.50 |
| CNS6 | 4.26 | 1.24 | 3.55 | 1.38 |
| **NEP** | **4.88** | **0.83** | **4.54** | **0.93** |
| NEP2 | 4.33 | 1.23 | 4.16 | 1.22 |
| NEP4 | 5.05 | 1.13 | 4.71 | 1.20 |
| NEP5 | 5.27 | 0.83 | 4.77 | 1.30 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.

Table B1 (cont.). Mean scores and standard deviations of the items of the environmental education and attitude variables. Data are shown by each university sample.

| Variables/ Items | Yokohama National *(n* = 110) | | The University of Tokyo (*n* = 19) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| **CE** | **3.32** | **0.72** | **3.94** | **0.91** |
| CE1 | 4.67 | 1.18 | 5.37 | 0.96 |
| CE2 | 3.07 | 1.22 | 3.47 | 1.35 |
| CE3 | 3.24 | 1.14 | 3.95 | 1.03 |
| CE4 | 2.58 | 1.04 | 3.11 | 1.33 |
| CE5 | 3.02 | 0.93 | 3.79 | 1.27 |
| **CK** | **3.28** | **0.74** | **3.91** | **1.00** |
| CK1 | 3.64 | 0.97 | 4.32 | 1.00 |
| CK2 | 3.40 | 0.92 | 4.05 | 1.13 |
| CK3 | 3.54 | 1.00 | 4.37 | 1.01 |
| CK4 | 3.03 | 1.01 | 4.68 | 1.25 |
| CK5 | 2.78 | 0.93 | 3.11 | 1.41 |
| **UE** | **2.03** | **0.66** | **2.01** | **0.61** |
| UE1 | 3.62 | 1.41 | 2.95 | 1.13 |
| UE2 | 1.99 | 1.13 | 1.53 | 0.61 |
| UE3 | 2.28 | 0.97 | 2.63 | 0.90 |
| UE4 | 1.80 | 1.03 | 1.74 | 1.24 |
| UE5 | 0.44 | 0.98 | 1.21 | 1.48 |
| **UK** | **2.65** | **0.88** | **3.04** | **1.04** |
| UK1 | 2.88 | 1.09 | 3.11 | 1.45 |
| UK2 | 2.60 | 1.10 | 2.84 | 1.21 |
| UK3 | 2.82 | 1.07 | 3.16 | 1.07 |
| UK4 | 2.50 | 1.07 | 3.05 | 1.18 |
| UK5 | 2.42 | 1.12 | 3.05 | 1.22 |
| **CNS** | **3.33** | **0.74** | **3.46** | **0.98** |
| CNS1 | 3.76 | 1.00 | 4.16 | 1.26 |
| CNS3 | 3.55 | 1.06 | 3.74 | 1.37 |
| CNS4 | 2.72 | 1.18 | 2.68 | 1.20 |
| CNS6 | 3.27 | 1.14 | 3.26 | 1.33 |
| **NEP** | **4.21** | **0.79** | **4.37** | **0.84** |
| NEP2 | 3.97 | 1.10 | 3.84 | 1.21 |
| NEP4 | 4.28 | 1.01 | 4.42 | 0.90 |
| NEP5 | 4.38 | 1.18 | 4.84 | 1.17 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.

Table B1 (cont.). Mean scores and standard deviations of the items of the environmental education and attitude variables. Data are shown by each university sample.

| Variables/ Items | Tokyo Gakugei ($n$ = 30) | | Saitama ($n$ = 217) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| **CE** | **3.79** | **1.02** | **3.44** | **0.81** |
| CE1 | 5.03 | 1.45 | 4.65 | 1.28 |
| CE2 | 3.70 | 1.39 | 3.55 | 1.43 |
| CE3 | 3.90 | 1.30 | 3.14 | 1.19 |
| CE4 | 2.88 | 1.17 | 2.89 | 0.99 |
| CE5 | 3.46 | 1.32 | 2.99 | 1.10 |
| **CK** | **3.61** | **0.75** | **3.39** | **0.88** |
| CK1 | 3.90 | 0.92 | 3.83 | 1.12 |
| CK2 | 3.63 | 0.93 | 3.68 | 1.15 |
| CK3 | 3.87 | 1.01 | 3.60 | 1.03 |
| CK4 | 3.40 | 1.16 | 3.06 | 1.10 |
| CK5 | 3.23 | 1.22 | 2.80 | 1.11 |
| **UE** | **3.47** | **0.69** | **2.02** | **0.75** |
| UE1 | 4.63 | 1.03 | 3.20 | 1.21 |
| UE2 | 3.37 | 1.33 | 2.12 | 1.42 |
| UE3 | 2.73 | 0.91 | 2.07 | 0.99 |
| UE4 | 2.90 | 1.30 | 1.88 | 1.30 |
| UE5 | 3.70 | 1.18 | 0.83 | 1.08 |
| **UK** | **3.60** | **0.80** | **2.68** | **1.01** |
| UK1 | 3.63 | 1.40 | 3.10 | 1.29 |
| UK2 | 3.93 | 1.20 | 2.82 | 1.24 |
| UK3 | 4.00 | 0.98 | 2.84 | 1.15 |
| UK4 | 3.40 | 1.22 | 2.41 | 1.23 |
| UK5 | 3.03 | 1.25 | 2.24 | 1.21 |
| **CNS** | **3.91** | **0.73** | **3.59** | **0.86** |
| CNS1 | 4.80 | 0.89 | 4.25 | 1.02 |
| CNS3 | 4.17 | 1.21 | 3.61 | 1.18 |
| CNS4 | 3.37 | 1.30 | 3.02 | 1.40 |
| CNS6 | 3.30 | 0.99 | 3.49 | 1.21 |
| **NEP** | **4.39** | **0.96** | **4.25** | **0.85** |
| NEP2 | 3.83 | 1.37 | 3.96 | 1.16 |
| NEP4 | 4.63 | 1.19 | 4.41 | 1.08 |
| NEP5 | 4.70 | 1.18 | 4.38 | 1.18 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.

Table B1 (cont.). Mean scores and standard deviations of the items of the environmental education and attitude variables. Data are shown by each university sample.

| Variables/ Items | Kyoei ($n$ = 57) | | Aoyama Gakuin ($n$ = 6) | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| **CE** | **3.72** | **0.81** | **4.33** | **1.16** |
| CE1 | 5.02 | 1.19 | 5.00 | 1.27 |
| CE2 | 3.77 | 1.51 | 4.17 | 1.84 |
| CE3 | 3.82 | 1.33 | 4.67 | 1.37 |
| CE4 | 2.90 | 1.05 | 4.17 | 0.98 |
| CE5 | 3.07 | 1.15 | 3.67 | 1.03 |
| **CK** | **3.56** | **0.71** | **3.83** | **0.67** |
| CK1 | 4.04 | 1.02 | 4.00 | 0.63 |
| CK2 | 3.82 | 0.95 | 3.83 | 0.98 |
| CK3 | 3.68 | 0.78 | 4.50 | 0.84 |
| CK4 | 3.19 | 0.92 | 3.50 | 1.05 |
| CK5 | 3.05 | 0.97 | 3.33 | 0.52 |
| **UE** | **2.43** | **0.84** | **2.30** | **0.79** |
| UE1 | 4.19 | 1.42 | 2.33 | 0.82 |
| UE2 | 2.54 | 1.69 | 3.17 | 1.47 |
| UE3 | 2.39 | 1.32 | 3.17 | 1.47 |
| UE4 | 1.98 | 1.20 | 1.50 | 0.84 |
| UE5 | 1.04 | 1.36 | 1.33 | 1.03 |
| **UK** | **2.67** | **0.99** | **2.47** | **1.06** |
| UK1 | 2.63 | 1.19 | 2.67 | 1.21 |
| UK2 | 2.46 | 1.12 | 2.50 | 1.38 |
| UK3 | 2.91 | 1.14 | 2.83 | 1.17 |
| UK4 | 2.72 | 1.13 | 2.17 | 1.17 |
| UK5 | 2.65 | 1.13 | 2.17 | 0.98 |
| **CNS** | **3.48** | **0.79** | **3.49** | **0.77** |
| CNS1 | 4.02 | 1.09 | 3.83 | 0.98 |
| CNS3 | 3.62 | 1.25 | 3.50 | 1.05 |
| CNS4 | 3.04 | 1.24 | 3.17 | 0.98 |
| CNS6 | 3.25 | 1.11 | 3.47 | 1.03 |
| **NEP** | **4.09** | **1.05** | **4.22** | **0.89** |
| NEP2 | 3.66 | 1.42 | 3.83 | 0.98 |
| NEP4 | 4.20 | 1.38 | 5.00 | 0.89 |
| NEP5 | 4.41 | 1.29 | 3.83 | 0.98 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm.

Table B2. Mean scores and standard deviations of the items of the environmental education and attitude variables for the SFB, TB, and ALL samples.

| Variables/ Items | SFB (n=470) | | TB (n=796) | | ALL (n=1266) | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| **CE** | **3.84** | **0.92** | **3.60** | **0.85** | **3.69** | **0.88** |
| CE1 | 4.96 | 1.07 | 4.71 | 1.25 | 4.80 | 1.20 |
| CE2 | 3.71 | 1.44 | 3.59 | 1.39 | 3.64 | 1.41 |
| CE3 | 4.19 | 1.27 | 3.46 | 1.27 | 3.73 | 1.32 |
| CE4 | 3.03 | 1.27 | 2.90 | 1.12 | 2.95 | 1.18 |
| CE5 | 3.29 | 1.21 | 3.36 | 1.14 | 3.33 | 1.17 |
| **CK** | **3.95** | **1.08** | **3.42** | **0.88** | **3.62** | **0.99** |
| CK1 | 4.55 | 1.13 | 3.90 | 1.11 | 4.14 | 1.16 |
| CK2 | 4.38 | 1.16 | 3.67 | 1.11 | 3.93 | 1.18 |
| CK3 | 4.06 | 1.27 | 3.71 | 1.08 | 3.84 | 1.17 |
| CK4 | 3.48 | 1.41 | 3.05 | 1.16 | 3.21 | 1.28 |
| CK5 | 3.28 | 1.46 | 2.78 | 1.12 | 2.97 | 1.28 |
| **UE** | **3.15** | **1.16** | **2.24** | **0.82** | **2.57** | **1.06** |
| UE1 | 3.97 | 1.44 | 3.73 | 1.39 | 3.82 | 1.41 |
| UE2 | 2.93 | 1.51 | 2.21 | 1.43 | 2.47 | 1.50 |
| UE3 | 3.68 | 1.39 | 2.33 | 1.11 | 2.83 | 1.38 |
| UE4 | 3.25 | 1.51 | 2.05 | 1.38 | 2.49 | 1.54 |
| UE5 | 1.91 | 1.72 | 0.88 | 1.27 | 1.25 | 1.54 |
| **UK** | **4.33** | **1.22** | **2.86** | **1.13** | **3.40** | **1.36** |
| UK1 | 4.11 | 1.58 | 2.96 | 1.45 | 3.39 | 1.60 |
| UK2 | 4.14 | 1.63 | 2.76 | 1.41 | 3.27 | 1.63 |
| UK3 | 4.65 | 1.39 | 3.14 | 1.33 | 3.70 | 1.54 |
| UK4 | 4.42 | 1.42 | 2.83 | 1.38 | 3.42 | 1.59 |
| UK5 | 4.30 | 1.52 | 2.63 | 1.33 | 3.25 | 1.62 |
| **CNS** | **4.53** | **0.98** | **3.63** | **0.93** | **3.97** | **1.05** |
| CNS1 | 5.07 | 1.11 | 4.17 | 1.18 | 4.51 | 1.23 |
| CNS3 | 4.46 | 1.35 | 3.71 | 1.25 | 3.99 | 1.34 |
| CNS4 | 4.42 | 1.40 | 3.17 | 1.41 | 3.64 | 1.53 |
| CNS6 | 4.16 | 1.31 | 3.45 | 1.27 | 3.72 | 1.33 |
| **NEP** | **5.08** | **0.79** | **4.38** | **0.91** | **4.64** | **0.93** |
| NEP2 | 4.64 | 1.21 | 4.02 | 1.22 | 4.25 | 1.25 |
| NEP4 | 5.27 | 1.04 | 4.53 | 1.16 | 4.81 | 1.17 |
| NEP5 | 5.33 | 0.89 | 4.58 | 1.25 | 4.87 | 1.20 |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm. SFB: San Francisco Bay Area. TB: Tokyo Bay Area. ALL: SFB + TB.

Table B3. Mean scores and standard deviations of the environmental education and attitude variables for each university sample and their total data. Standard deviations are written in parentheses.

| Sample | *n* | CE | CK | UE | UK | CNS | NEP |
|---|---|---|---|---|---|---|---|
| 1 | 190 | 3.66 (0.89) | 3.76 (1.14) | 2.53 (1.03) | 3.95 (1.32) | 4.34 (1.07) | 5.11 (0.81) |
| 2 | 150 | 3.96 (0.97) | 4.02 (1.08) | 3.87 (1.00) | 4.69 (1.06) | 4.74 (0.90) | 5.23 (0.70) |
| 3 | 130 | 3.96 (0.87) | 4.14 (0.95) | 3.21 (1.01) | 4.45 (1.08) | 4.54 (1.08) | 4.88 (0.83) |
| 4 | 357 | 3.72 (0.86) | 3.42 (0.93) | 2.32 (0.82) | 3.01 (1.27) | 3.75 (1.03) | 4.54 (0.93) |
| 5 | 110 | 3.32 (0.72) | 3.28 (0.74) | 2.03 (0.66) | 2.65 (0.88) | 3.33 (0.74) | 4.21 (0.79) |
| 6 | 19 | 3.94 (0.91) | 3.91 (1.00) | 2.01 (0.61) | 3.04 (1.04) | 3.46 (0.98) | 4.37 (0.84) |
| 7 | 30 | 3.79 (1.02) | 3.61 (0.75) | 3.47 (0.69) | 3.60 (0.80) | 3.91 (0.73) | 4.39 (0.96) |
| 8 | 217 | 3.44 (0.81) | 3.39 (0.88) | 2.02 (0.75) | 2.68 (1.01) | 3.59 (0.86) | 4.25 (0.85) |
| 9 | 57 | 3.72 (0.81) | 3.56 (0.71) | 2.43 (0.84) | 2.67 (0.99) | 3.48 (0.79) | 4.09 (1.05) |
| 10 | 6 | 4.33 (1.16) | 3.83 (0.67) | 2.30 (0.79) | 2.47 (1.06) | 3.49 (0.77) | 4.22 (0.89) |
| SFB | 470 | 3.84 (0.92) | 3.95 (1.08) | 3.15 (1.16) | 4.33 (1.22) | 4.53 (0.98) | 5.08 (0.79) |
| TB | 796 | 3.60 (0.85) | 3.42 (0.88) | 2.24 (0.82) | 2.86 (1.13) | 3.63 (0.93) | 4.38 (0.91) |
| ALL | 1266 | 3.69 (0.88) | 3.62 (0.99) | 2.57 (1.06) | 3.40 (1.36) | 3.97 (1.05) | 4.64 (0.93) |

*Notes:* CE: Childhood Experience. CK: Childhood Knowledge. UE: University Experience. UK: University Knowledge. CNS: Connectedness to Nature Scale. NEP: New Ecological Paradigm. 1 San José State University. 2 UC, Santa Cruz. 3 Santa Clara University. 4 Soka University. 5 Yokohama National University. 6 The University of Tokyo. 7 Tokyo Gakugei University. 8 Saitama University. 9 Kyoei University. 10 Aoyama Gakuin University. SFB: San Francisco Bay Area (University 1-3). TB: Tokyo Bay Area (University 4-10). ALL: SFB + TB.

Table C. The most influential factor for obtaining nature-related experience and environmental knowledge for each university sample and their total data

| Sample | Experience Factor | | | | | |
|---|---|---|---|---|---|---|
| | Family (%) | Friends (%) | School (%) | Organization (%) | Other (%) | Multiple (%) |
| 1 | 56 (31.8) | 31 (17.6) | **62 (35.2)** | 17 (9.7) | 9 (5.1) | 1 (0.6) |
| 2 | 47 (34.1) | 22 (15.9) | **50 (36.2)** | 8 (5.8) | 5 (3.6) | 6 (4.3) |
| 3 | **46 (38.0)** | 18 (14.9) | 43 (35.5) | 13 (10.7) | 1 (0.8) | 0 (0.0) |
| 4 | 104 (31.7) | 50 (15.2) | **150 (45.7)** | 15 (4.6) | 9 (2.7) | 0 (0.0) |
| 5 | 25 (24.0) | 19 (18.3) | **46 (44.2)** | 9 (8.7) | 2 (1.9) | 3 (2.9) |
| 6 | 6 (31.6) | 2 (10.5) | **8 (42.1)** | 3 (15.8) | 0 (0.0) | 0 (0.0) |
| 7 | 8 (28.6) | 1 (3.6) | **16 (57.1)** | 2 (7.1) | 1 (3.6) | 0 (0.0) |
| 8 | 35 (20.0) | 17 (9.7) | **107 (61.1)** | 13 (7.4) | 1 (0.6) | 2 (1.1) |
| 9 | 14 (24.6) | 10 (17.5) | **19 (33.3)** | 9 (15.8) | 4 (7.0) | 1 (1.8) |
| 10 | **5 (83.3)** | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (16.7) | 0 (0.0) |
| SFB | 149 (34.3) | 71 (16.3) | **155 (35.6)** | 38 (8.7) | 15 (3.4) | 7 (1.6) |
| TB | 197 (27.5) | 99 (13.8) | **346 (48.3)** | 51 (7.1) | 18 (2.5) | 6 (0.8) |
| ALL | 346 (30.0) | 170 (14.8) | **501 (43.5)** | 89 (7.7) | 33 (2.9) | 13 (1.1) |

| Sample | Knowledge Factor | | | | | | |
|---|---|---|---|---|---|---|---|
| | Family (%) | Friends (%) | School (%) | Organization (%) | Media (%) | Other (%) | Multiple (%) |
| 1 | 13 (7.4) | 7 (4.0) | **116 (66.3)** | 8 (4.6) | 28 (16.0) | 0 (0.0) | 3 (1.7) |
| 2 | 4 (2.9) | 1 (0.7) | **105 (76.1)** | 7 (5.1) | 16 (11.6) | 1 (0.7) | 4 (2.9) |
| 3 | 4 (3.3) | 0 (0.0) | **104 (86.0)** | 3 (2.5) | 8 (6.6) | 1 (0.8) | 1 (0.8) |
| 4 | 30 (9.3) | 15 (4.7) | **194 (60.2)** | 15 (4.7) | 65 (20.2) | 3 (0.9) | 0 (0.0) |
| 5 | 3 (2.8) | 4 (3.8) | **60 (56.6)** | 5 (4.7) | 33 (31.1) | 0 (0.0) | 1 (0.9) |
| 6 | 1 (5.6) | 0 (0.0) | **13 (72.2)** | 0 (0.0) | 4 (22.2) | 0 (0.0) | 0 (0.0) |
| 7 | 2 (6.9) | 0 (0.0) | **14 (48.3)** | 4 (13.8) | 9 (31.0) | 0 (0.0) | 0 (0.0) |
| 8 | 5 (2.9) | 4 (2.3) | **140 (80.0)** | 3 (1.7) | 21 (12.0) | 0 (0.0) | 2 (1.1) |
| 9 | 3 (5.3) | 1 (1.8) | **37 (64.9)** | 2 (3.5) | 13 (22.8) | 0 (0.0) | 1 (1.8) |
| 10 | 2 (33.3) | 0 (0.0) | **3 (50.0)** | 1 (16.7) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| SFB | 21 (4.8) | 8 (1.8) | **325 (74.9)** | 18 (4.1) | 52 (12.0) | 2 (0.5) | 8 (1.8) |
| TB | 46 (6.5) | 24 (3.4) | **461 (64.7)** | 30 (4.2) | 145 (20.3) | 3 (0.4) | 4 (0.6) |
| ALL | 67 (5.8) | 32 (2.8) | **786 (68.5)** | 48 (4.2) | 197 (17.2) | 5 (0.4) | 12 (1.0) |

*Notes:* Mode is written in bold type. Respondents who selected several choices are categorized in Multiple.

1 San José State University (n = 190). 2 UC, Santa Cruz (n = 150). 3 Santa Clara University (n =130). 4 Soka University (n = 357). 5 Yokohama National University (n = 110). 6 The University of Tokyo (n = 19). 7 Tokyo Gakugei University (n = 30). 8 Saitama University (n = 217). 9 Kyoei University (n = 57). 10 Aoyama Gakuin University (n = 6).

SFB: San Francisco Bay Area (University 1-3). TB: Tokyo Bay Area (University 4-10). ALL: SFB + TB.