

A Meta-analysis of Global Youth Environmental Knowledge, Attitude and Behavior Studies

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There is a considerable body of literature on research on environmental knowledge, attitude and action. A lot of research has occurred on the primary and secondary school populations and the general population. However, much less emphasis has been placed on studies that concern post-compulsory education students in the range from 16 to 18 years old. The purpose of this review was to give an overview of environmental knowledge, attitude and action research with a particular emphasis on youth. The findings of a majority of studies reported a positive attitude towards the environment and a variety of levels of environmental knowledge. Behavior was not extensively studied. A number of studies found that females had a more positive attitude towards the environment than males. The majority of studies indicate that the main sources of environmental information for youth are television, books, newspapers, schools and friends. The main environmental problems mentioned by students were air pollution, water pollution, the loss of biological diversity and “population increase in the big cities” and hazardous waste. Most studies used quantitative techniques to gather data. The most commonly used instrument was a questionnaire with multiple choice questions and a Likert type scale particularly to measure attitudes. Considering the mainly quantitative nature of these studies, more appropriate sampling strategies, contextualized research instruments and statistical analysis should have been carried out to ensure more robust statistical findings.

Keywords: meta-analysis, environmental attitudes, environmental behavior, environmental knowledge, youth

Introduction

This review provides a comprehensive survey of environmental knowledge, attitude and action studies, focusing on youth studies from post-secondary institutions. However, studies from the last secondary school year have also been included to account for differences in educational settings in different countries. Some studies in the earlier secondary schools and late years of primary schools have also been reviewed to allow comparison.

Prominent journals were searched including: *Canadian Journal of Environmental Education*, *Environmental Education Research*, *International Research in Geographical and Environmental Education* and the *Journal of Environmental Education*. Additionally, government-funded studies and other studies published in books and thesis were also analyzed.

The Studies

Twenty one papers that evaluated existing behavior, attitude or knowledge levels were found. The relevant

characteristics of these studies are summarized in Table 1. The critical analysis of the studies is presented in ascending order of the size of the sample.

Table 1

National Studies of Individual Regions or Countries

Author	Country	Sample derived from	Methodology	Sample size
Alp, Ertepinar, Tekkaya, and Yilmaz (2006)	Turkey	11 to 17 years old	Quantitative	1,977 students
Barrett and Kuroda (2002)	Japan	High school students	Quantitative	1,009 students
Bradley, Waliczek, and Zajicek (1999)	USA	High school students	Quantitative	475 students
Eagles and Demare (1999)	Canada	The sixth grade students	Quantitative	72 students
Gambro and Switzky (1996)	USA	High school students	Quantitative	Extracted from a national probability sample of 2,900
Gambro and Switzky (1999)	USA	High school students.	Quantitative	Extracted from a national probability sample of 2,200
Gigliotti (1994)	USA	Undergraduate students	Quantitative	1,050 effective mailed back questionnaires
Hampel, Holdsworth, and Boldero (1996)	Australia	15 to 16 years old students	Quantitative and qualitative	661 students
Hodgkinson and Innes (2001)	Australia	The first year university students	Quantitative	391 students
Ivy, Lee, and Chuan (1998)	Singapore	Upper secondary and junior college	Quantitative	1,256 students
Kaplowitz and Levine (2005)	USA	University students	Quantitative	19,890 students
Korhonen and Lappalainen (2004)	Madagascar	Eight to 21 years old	Quantitative and qualitative	400 students
Kuhlemeier, Huub Van Den, and Nijs (1999)	Netherlands	Upper secondary school students	Quantitative	9,000 students
Makki, Abd-El-Khalick, and Boujaoude (2003)	Lebanon	Upper secondary school	Quantitative	660 students
Mogenson and Nielsen (2001)	Denmark	Primary, secondary and upper secondary students	Quantitative	845 students
Negev, Sagy, Garb, Salzberg, and Tal (2008)	Israel	The sixth and 12th grade students	Quantitative	3,121 students
Pawlowski (1996)	Poland	University students	Quantitative	200 students
Said, Yahaya, and Ahmadun, (2007)	Malaysia	Age distribution from 15 to 17 years old	Quantitative	306 students
Salmivalli (1998)	Finland	Age distribution from 10 to 15 years old	Quantitative	183 students
Sivek (2002)	USA	High school students	Qualitative (focus groups)	64 students
Tuncer, Ertepinar, Tekkaya, and Sungur (2005)	Turkey	Last year secondary and the first year college	Quantitative	1,497 students

Sivek (2002) conducted a study to assess the influences on ES (environmental sensitivity) in Wisconsin High School students. ES includes an empathetic or understanding view of the environment. It is characterized by the individual who refuses to litter in highways and natural areas, conserves natural resources and works to preserve ecologically important areas (Hungerford, Litherland, Peyton, Ramsey, & Volk, 1992). ES is a variable that appears to be an important precursor to EL (environmental literacy) which consists of cognitive and affective attributes that lead individuals towards environmentally responsible behaviors. Indicators of EL include knowledge and concern about the environment, perception of ability to bring about change, and citizen action skills and experience. The research involved a two-phase study. Phase 1 employed a qualitative methodology with a focus group design, while Phase 2 employed a paper survey. Questions for the focus group

interviews were developed according to the methodology suggested by Krueger (1994) who employs the following sequence:

- (1) The opening question introduces the general topic and is factually based;
- (2) The introductory question further focuses on the topic and allows participants to reflect on past experiences;
- (3) The transition question helps move the conversation into key questions;
- (4) The key questions focus entirely on the topic of interest;
- (5) Three types of ending questions are as follows: The first is where participants state their final position on the topic; The second starts with the interviewer summarizing the interview and asking if it is an adequate summary; and The final question asks "have we missed anything?" (Krueger, 1994; as cited in Sivek, 2002).

The focus group interviews were conducted by five graduate students, and the female interviewers (4) were asked to interview female students, while the male interviewer was asked to interview male students. The author argues that this was done, because the respondents were probably "more open to share gender sensitive information with a same gender interviewer" (Sivek, 2002). Participants in the focus group were nominated by teachers, which resulted in two groups of six females and two groups of four males. Three broad conceptual categories emerged from the focus groups: environmental influences (external influences other than role models), role model influences (persons having influences on ES) and personality influences (defined as psychosocial factors). The major influences on ES mentioned by the respondents were role models and outdoor influences. Teachers and school related role models were mentioned more often than parents or other familial role models. The results also suggest that though media are an important factor in ES, they are not a major influence and probably serve a smaller supporting role.

Phase 2 of the study was based on the demographic data of the students and a self-identification of ES level by students and the results of the focus groups. Other sections of the study requested information regarding role models and traits, outdoor experiences, media influences and environmental issues. The sample included 64 students from nine schools. The results from this survey indicate that male teachers (mean = 3.39), fathers (mean = 3.00) and mothers (mean = 2.98) were the most influential role models.

One major concern with this study is that the students were a very select group, as they were all attending a high school environmental action conference with a highly trained environmental education teacher. Nonetheless, this is one of the very few qualitative studies that focus on high school students.

Eagles and Demare (1999) studied the factors that influenced children's environmental attitudes. The research involved the study of three classes of Grade 6 students at Wilmot Senior Public School in the Waterloo County Board of Education, Canada. The sample consisted of 72 students that undertook the Sun Ship the Earth Camp program (a week-long environmental education residential program).

A pre-test questionnaire was given to all students one week before their participation in the camp program in 1992, followed by an identical post-test questionnaire one week after their return from the camp. The questionnaire included eight personal information questions and 30 environmental attitude questions. The attitude questions contained 11 questions on ecologicistic attitudes, eight questions on moralistic attitudes and 11 questions on other attitudes. Each attitude statement required the student to choose one of five categories: "Strongly agree", "Agree", "Do not know", "Disagree" and "Strongly disagree".

Results indicate that ecologicistic and moralistic attitudes towards the environment correlated with talking about the environment at home, watching nature films and reading about the environment. There were no

gender differences in ecologicistic attitude, but girls showed higher moralistic attitude scores. In addition, the week-long Sun Ship the Earth Camp program at a residential camp did not produce any measurable differences in ecologicistic or moralistic attitudes. Without a control group, we cannot be sure that changes or otherwise in these attitudes were due to this program. Other concerns about this study are the relatively small sample and the fact that the student's pre- and post- test responses could not be compared statistically, as the schools did not allow the identity of students to be disclosed. Therefore, the results should be treated with caution.

Salmivalli (1998) administered the Canadian CERI (children's environmental response inventory) and the DTT (directing traits test) with Finnish young people. CERI was developed by Bunting and Cousins in 1985 and is a test that measures a child's attitudes about his/her environment. The CERI was translated as literally as possible into Finnish. The inventory consists of eight factors plus "communality" which evaluates test-taking attitudes. The eight factors include: pastoralism, urbanism, environmental adaptation, stimulus seeking, environmental trust, antiquarianism and need for privacy and mechanical orientation. The inventory includes 185 questions with a five-point Likert type answer scale. The validity of the CERI was checked by two researchers that read all the questions and compared the contents of the questions with the cultural attitude of the Finns. Subsequently, some of the questions were slightly altered to better suit Finnish adolescents.

The DTT involves the use of a sketchy image of the future that helps discover what things are of value to a child. The test includes an inventory in which children choose the two best alternatives and the two second best alternatives. The DTT includes four directing traits: willingness to perform, love of adventure, love of liberty and need for security.

The sample was composed of 183 participants: 85 boys and 98 girls with an age distribution from 10 to 15 years. The students were all from schools in Turku, a city of 160,000 in Southwestern Finland. All the participants completed the CERI, while the older students (72 participants) also completed the DTT. The inventories were performed during a 45-minute lesson.

The CERI factors were correlated with the corresponding factors on the DTT. Results indicate that some factors on CERI and DTT correlate positively with each other: stimulus-seeking (CERI) and love of adventure (DTT) ($r = 0.30$) and environmental trust (CERI) and need for security (DTT) ($r = 0.36$). Other factors in the two instruments had negative correlations including need for privacy (CERI), craving for power (DTT), mechanical orientation (CERI) and need for security (DTT).

Results indicated that there were no statistically significant differences among age groups with regard to environmental attitudes. A significant difference was found between the attitudes of boys and girls towards mechanical orientation, with boys were more interested in mechanical things than their female counterparts. The author concluded that, by comparing the CERI to the hobbies and the knowledge of nature of Finnish children and adolescents, teachers who are not familiar with environmental issues can obtain valuable information. It is not clear that, however, how the methodology used in this study can accomplish that goal. Other concerns include: the relative complexity of the instruments used together with the grouping of factors, the relatively small sample, and the differences in sample size between CERI and DTT and the very short time allotted to students to answer the inventory which make it very difficult to draw any meaningful implications.

Pawlowski (1996) studied the perception of environmental problems by young people in Poland. The study was conducted in 1994 among a sample of 200 students from the UMCS (University of Maria Curie-Sklodowska) and the TU (Technical University). The research instrument used was a 20-item questionnaire which was pre-tested to exclude unintelligible questions. Students could choose only one answer

out of five predefined given answers. The study showed that the vast majority of students are interested in environmental matters (74% at TU and 98% at UMCS). More than half of the students believed that the main reason for protecting nature was because it was necessary for humans to live and because we must preserve it for the next generation.

The study found that the main sources of environmental information for participating students were TV (television) (70% at TU and 53.5% at UMCS). Students also perceive newspapers as very informative (32% at TU and 52% at UMCS). It is interesting that for environmental students from UMCS, TV is more or less as informative as newspapers, but for students from the TU, TV is much more important than any other source. Less important sources are radio (5.5% at TU and 10% at UMCS) and school lessons (9% at TU and 3.5% at UMCS). Only a few students gain their knowledge from ecological books (textbooks). The study found that most students were ready to do something for the environment themselves (65% at TU and 81.5% at UMCS). Nearly all students surveyed (98% at TU and 100% at UMCS) answered that we cannot really help our environment without changing our lifestyles to a more environmentally friendly one.

The results indicated that students from both schools were aware of environmental problems, but the more “pro-ecological” group was the students studying protection of the environment (UMCS). One concern about this study is in its choice of pre-selected answers for students to choose from and a second concern is the total reliance on quantitative data with simple descriptive statistics.

The differences in environmental attitudes and beliefs among the first year university students in different disciplines were studied by Hodgkinson and Innes (2001). The authors hypothesized that students studying business and economics would cause economic beliefs to become significant, and therefore, these students would hold less positive attitudes towards the environment than those in the social sciences and environmental-related areas. The sample consisted of 391 students in their first semester of study at university. The authors used the NEP (New Environmental Paradigm) Scale (Dunlap & Van Liere, 1978) and the EAS (Environmental Attitude Scale) (Forgas & Jolliffe, 1994).

The responses indicated that most students had a positive attitude towards the environment. However, students responded to the “predicted pattern”, as students of sociology, biology and environmental studies displayed more positive pro-environmental attitudes on both scales than those of commerce and computing. Nonetheless, the authors argue that although the majority of university students have a positive attitude towards the environment, different disciplines may attract students of a particular attitudinal orientation. This statement may be true although it is not based on data, but there may be other factors involved. The findings highlight the importance of more research into students’ political and economic beliefs to inform future policy decisions.

Said, Yahaya, and Ahmadun (2007) conducted a survey in secondary schools in the State of Johor, Malaysia, with 306 students. The quantitative study included a questionnaire with sections on demography, sources of environmental information, concept of environment, environmental knowledge, environmental awareness and concern, sustainable consumption behaviors and nature-related activities. The results indicated that students were aware of environmental issues, but much less concerned about them. The three main environmental problems in Malaysia mentioned by students were air pollution (by 177 respondents), water pollution (159) and noise pollution (69). Results showed that mass media, especially TV, were the main suppliers of environmental information. The authors argue that although environmental education had raised the environmental consciousness of students, it did not have a desired effect on promoting pro-environmental behavior.

The objective of a comparative study by Korhonen and Lappalainen (2004) was to examine the environmental awareness and knowledge of children and adolescents' living in different ecological conditions in rural Madagascar. Two types of school survey among eight to 21 years old students in 18 schools were used for data collection. The information was collected using semi-structured questionnaires in primary and middle schools and open questionnaires in secondary schools.

The first survey included a total of 12 primary schools and four middle schools. A questionnaire in Malagasy was given to pupils and results were collected a few days later. About 400 responses were received and a random sample of 200 was chosen due to the financial cost of translation. The term "environment" was explained at the beginning of the questionnaire for primary and middle schools to avoid misunderstandings.

The results of the study indicated that young people were aware of environmental problems that are of direct concern to them. Pupils in deforested areas were more concerned about bush fires from charcoal burning, while pupils from forested areas were mostly concerned with "tavy" (local slash and burn agriculture). Environmental concern and action were much stronger in deforested areas. Pupils from deforested areas who had received some forms of environmental education were more empowered and willing to deal with environmental issues. The findings indicated a high level of environmental knowledge including environmental problems from pupils in deforested and forested areas. The importance of personal experience was highlighted by the fact that environmental education was most effective, when it offered hands on experience in addition to classroom theory.

The questionnaires used in this study had clear nuances with the environment and this may have influenced the results. Nonetheless, the data collected provided insights in the thinking of young people with regard to the environment in the Ramofana region in rural Madagascar.

Bradley, Waliczek, and Zajicek (1999) prepared a study on the relationship between environmental knowledge and attitudes of high school students. The students' environmental knowledge and attitudes were assessed from a questionnaire administered before and after exposure to a 10-day environmental science course.

The instrument included a section on knowledge and one on attitude. The knowledge section included 18 multiple-choice questions, having a Cronbach's alpha reliability coefficient of 0.64. The attitude section consisted of 15 questions rated in a Likert type scale and used to measure students' attitudes towards the protection of the environment. It was developed with a combination of existing measurement scales and had a Cronbach's alpha reliability coefficient of 0.72.

Results indicated that the student's environmental knowledge scores increased by 22% after they completed the environmental science course. In addition, students' environmental attitudes became more environmentally favorable. The findings also indicated that students having higher knowledge scores had more favorable environmental attitudes compared with those with lower knowledge scores. The authors suggest that these findings are important, as they imply that increased knowledge may help improve environmental attitude. One concern is that other outside influences, such as culture, religion and socio-economic status probably influence environmental attitudes as well. This study did not take these influences into account.

Makki et al. (2003) conducted a study to assess Lebanese secondary school students' environmental knowledge and attitudes and explore the relationship between participants' knowledge and biographical and academic variables. The sample included 660 (302 males and 358 females) Grade 10 and Grade 11 students in the Greater Beirut Area, Lebanon. The sample was selected from all the schools in the area which have more

than 50 secondary students (84). Proportional stratified sampling was used to generate a 12% sample of the 84 schools.

The research instrument was a two-part questionnaire to assess participants' environmental knowledge and attitudes. Questions from previously published instruments were included in the questionnaire and some questions were developed for this study. The study did not rely on any particular instrument, because available instruments were developed for countries with environmental concerns different from those in Lebanon.

Part 1 of the questionnaire included 34 multiple choice items that assessed pupils' environmental knowledge. Each question presents four different choices and students have to choose only one. Some of the questions were adapted from the CHEAKS (children's environmental attitude and knowledge scale). CHEAKS was developed by Leeming, Dwyer, and Bracken (1995). Part 2 of the questionnaire included 28 four-point Likert type items which aim to assess attitudes based on the theory of Fishbein and Ajzen (1975). Items assessed respondents' beliefs, affect and behavioral intentions. The questionnaire was examined by three experts in the field of science education and modified according to their suggestions for improvement. The translation of the English version to the French version was carried out by a language expert. The final questionnaire was piloted to one English speaking and one French speaking class.

The results indicated that Lebanese High School students held relatively uniform and favorable attitudes towards the environment, but poor knowledge of environmental issues. This is consistent with findings by Kuhlemeier et al. (1999) and Gambro and Switzky (1999). The authors suggest the supply of quality instructional materials, classroom support and focused training to ameliorate the situation.

The study found out that participants with "more educated" fathers had significantly higher environmental knowledge scores, while there was no significant relationship between the mother's educational level and the participants' environmental knowledge score. The reason given for this is that the Middle Eastern Lebanese culture is relatively male dominated, and therefore, the father is more likely to influence the households' "educational tone". The results also showed a low correlation between participants' environmental knowledge and attitudes, suggesting that the effect of knowledge on attitude is not direct but mediated by different factors.

Although the data collection and analyses of this research appear to have been carried out in a rigorous way, one concern is in its sole reliance on quantitative methods of data collection and analyses.

Hampel, Holdsworth, and Boldero (1996) studied the impact of parental work experience and education on environmental knowledge, concern and behavior among adolescents. The study was based on the data collected in 1993, and the schools were selected according to SES (socio-economic status), ethnic composition and rural location in Victoria, Australia. The sample consisted of students ranged from 661 15 to 16 years old. The instrument was piloted and comprised an 18-item environmental attitude/belief scale, a 20-item knowledge scale, a five-item environmental behavior scale and a ranking of 10-issue of most concern. Pupils were later selected for interview on the basis of their performances in the instrument: the top five girls and the top five boys that showed the highest level of concern and knowledge and the five of each that demonstrated the lowest levels for each school. The total sample of interviewed students was 117. The students were interviewed for about 40 to 70 minutes using questions derived from an extensive survey of literature on environmental education.

The results indicate that there is an almost linear relationship among the school rankings by SES and the combined score on the attitude, knowledge and behavior scales. As SES increased, the combined score increased as well. On the surface, the authors argue that it might be expected that lower SES people would be

more sensitized to environmental problems and more concerned about them than those in more socially advantaged circumstances. They have the most dangerous and dirty jobs and more often live in blighted urban areas near busy roads, toxic waste sites, polluting factories, power lines and contaminated water (Hallen, 1994; as cited in Hampel et al., 1996). In addition, girls' scores on attitude were generally higher than boys across the six schools ($p < 0.001$), while the boys were higher on knowledge ($p < 0.05$). The interview data obtained from the 117 low concern and high concern students indicates the importance of parental education or occupational status for increased environmental concern of students. For boys, the most significant correlations were father's education ($r = 0.51$) and mother's education ($r = 0.41$). On the other hand, the most significant correlations for girls were the mother's job ($r = 0.22$) and the father's job ($r = 0.21$). Father's education ($r = 0.07$) and mother's education ($r = 0.21$) were less important for girls' increased environmental concern. In commenting on the patterns, it is important to note that girls' scores on attitudes were generally higher than boys across the six schools, while the boys' were higher on knowledge. The data indicates that high environmental concern adolescents have a greater interest in politics and this probably reflects their parents' higher education and greater capacity to involve them in politics.

This study used a relatively large sample which makes it possible to generalize about certain research findings. One concern about this research is that the interview sample was drawn from the highest and lowest score on the screening test and, therefore, increasing the possible effect of regression towards the mean. In addition, no details were given on how the interviews were carried out except for the time taken and that they were based on an extensive literature review. A better representation of the qualitative data could have been obtained by simply presenting actual students' responses in their own words.

Mogenson and Nielsen (2001) made a study of students' knowledge about environmental matters and their BOAP (beliefs in their own action possibilities) in Denmark. The research involved the use of a seven-page questionnaire containing 29 open and closed questions. The sample included 845 individual students from primary, secondary and upper secondary schools. The questionnaire was divided into three categories: awareness of one's participation in solving environmental problems, belief in one's own influence in solving environmental problems and desire or inclination to act.

Results indicated that about half of the students believe in their own action's possibilities. In addition, the level of BOAP was higher in girls than in boys. The problem of pollution (17%) was the most frequently mentioned environmental problem. The students (30%) blamed lack of awareness or inappropriate behavior as the main cause of environmental problems. A positive aspect of the results was that 41.6% of students indicated that teaching may be one way of developing BOAP. Nonetheless, this study would have benefited from an extended analyses and discussion of the results, as they are presented in a rather concise way, and few comparisons between the different age groups in the sample were observed.

Barrett and Kuroda (2002) studied the environmental knowledge, attitudes and behaviors of young people in two localities in Japan. The sample included 1,009 high school students (15 to 16 years old) at 13 schools in Iwate Prefecture. These findings were then directly compared with a similar survey by Satoshi Ichikawa in 1996. This survey included eight schools in Tokyo and the sample size was 1,161 students.

The questionnaire included 12 statements that reflect the criteria established under the NEP (New Environmental Paradigm). The notion of the NEP as a replacement of the dominant social paradigm (separation of humans from nature and beliefs in progress, materialism and technology) was proposed and further developed by Dunlap and Van Liere (1978) and was characterized by the recognition that humans were a part

of nature and that there were limits to growth and development.

The 12 statements were used to determine the degree to which the respondents have moved away from previous social paradigms, and the extent to which they agree or disagree with the following statements:

- (1) Science and technology have improved our quality of life;
- (2) Because we are human, we are not subject to the laws of nature as are other species;
- (3) People should adapt to the environment wherever possible;
- (4) Modern technology has reduced our freedom and independence;
- (5) Natural resources should be saved for the benefit of future generations;
- (6) Modern industrial countries are very seriously disturbing the balance of nature;
- (7) The earth is like a spaceship with limited room and resources;
- (8) People must learn to control nature in order to survive;
- (9) Science and technology will always be able to find solutions to our problems;
- (10) Complex technologies will always be risky because of the chance of human error;
- (11) Economic growth should be given priority over environmental protection;
- (12) Nature should be used to produce goods for people.

These statements differ slightly from those presented by Dunlap and Van Liere (1978), as they include an emphasis on science and technology which was missing in the original formulation. A major limitation of the original NEP scale is the tendency to present environmental attitudes as uni-dimensional in terms of the balance of nature, limits to growth and human-nature relationship. This constraint has been addressed by additional issues, such as the role of science and technology, and through a preliminary correlation of the responses against predetermined environmental knowledge orientations.

The majority of young people (83% in Tokyo and 71% in Iwate) believe that Japan should concentrate on protecting the environment, even if it means some reduction of economic growth. The study indicated that the majority of students consider "household rubbish and garbage" as the main local environmental issue, while "destruction of the ozone layer" was regarded as the most important global environmental issue, which is probably a reflection of the date of study.

With regard to environmental knowledge, the respondents were very familiar with terms, such as "ozone layer", "ecology" and the "greenhouse effect", and less familiar with terms, such as "precautionary principle", "renewable resources" and "intergenerational equity".

The results indicated that the main sources of environmental information for Japanese youth were TV (49% in Tokyo and 66% in Iwate), newspapers (26% in Tokyo and 26% in Iwate), school (17% in Tokyo and 18% in Iwate) and friends (7% in Tokyo and 11% in Iwate). Even though Japan is a relatively advanced technological society, few students have beliefs that are consistent with the technological paradigm (15% in Tokyo and 16% in Iwate). The majority supported the environmental paradigm (61% in Tokyo and 58% in Iwate).

With regard to environmental action, students supported a mix of personal lifestyle changes, communities working together and governmental regulation. Popular environmental actions include recycling activities (61% Tokyo and 55% in Iwate), choosing green products (41% Tokyo) and cleaning up campaigns (29% Iwate). Nonetheless, only 35% of respondents in Tokyo and 64% in Iwate stated that they had taken a deliberate action to improve the environment. The main reasons indicated for this are that, "It will not make much difference" (59% in Tokyo and 49% in Iwate) and "There is no practical alternative" (59% in Tokyo and 38% in Iwate).

Gigliotti (1994) studied the relative importance of various environmental issues and the willingness to take action to help solve environmental problems in Cornell University students. The study involved a 12-page, self-administered and mail-back questionnaire to 1,500 randomly selected Cornell University undergraduate students in October 1990. This was followed by a postcard reminder and two subsequent questionnaire mailings to non-respondents. This multiple mailing approach achieved a response rate of 70% (consequently an actual sample of 1,050).

The results indicate that the reduction of hazardous waste (14.3%) and improvement of air quality (13.5%) are the two most important environmental issues for the students. The conservation of endangered species seems to be least important (10.3%). Nonetheless, it is important to note that the spread between least and most important was only 4%.

With regard to the acceptability of trade-off to solve environmental problems, there was a very wide spread of responses. Nonetheless, the most acceptable trade-off in a seven-point scale included: voluntary lifestyle change (6.1), government programs requiring increased user fees for services (4.7) and government programs funded through increased taxes (4.2).

This is one of the few studies that focused on the acceptability of trade-off and it seems that in terms of future research, measures of willingness to make personal sacrifices are better discriminating measures of environmental attitudes. Nonetheless, the results should be interpreted with caution, as they only reflect the attitudes of students at Cornell University and exclude those from other regions, other socio-economic backgrounds and those who do not have a college education.

Ivy, Lee, and Chuan (1998) studied the level of environmental knowledge, attitude and behavior of secondary and junior college students in Singapore. The quantitative study included a survey questionnaire of 55 items grouped in four sections: understanding and knowledge, attitude towards the environment, frequency of environmental tasks performed and perception of environmental problems.

The questionnaire was pilot tested on 316 students from two secondary schools and one junior college, and the reliability of the instrument was assessed by deriving the Cronbach's alpha. The final sample size of 1,256 consisted of 902 secondary (Grade 9) and 354 junior college freshmen. The sample consisted of 43% males and 57% females. The sampling procedure included the selection of schools based on academic performance and a choice of intact classes from within each school.

Singapore students' environmental knowledge is higher than a number of environmental knowledge and attitude studies in other countries cited by the study (Richmond, 1976; Blum, 1984; as cited in Ivy et al., 1998). The higher mean environmental knowledge score was effectively attributed to the greater exposure through mass media in Singapore. One concern is that the study is compared to studies which are some 20 years older, and access to mass media is more limited at that time. Nonetheless, the study illustrated the importance of media as sources of environmental information as perceived by students.

The environmental attitude was termed to be "moderately positive", as the mean environmental attitude score of the whole sample was 66%. Students' attitudes were more positive on global environmental issues like ocean dumping rather than local environmental issues like the need to decrease car use. Generally, the study indicated that students said that they frequently practiced positive environmental behavior. Results showed that the most frequently practiced positive environmental behaviors were saving electricity (61%) and saving paper (44%).

The main sources of environmental information mentioned by students were newspapers, books and

magazines (37.5%), general education at school (30.7%) and radio and television (16.3%). The results indicated the importance of media in the dissemination of environmental knowledge. The most important global environmental problems mentioned by students were ozone depletion (41.6%) and global warming (17.8%). The two main local environmental problems were rubbish disposal (17.7%) and land use (17.4%). One concern with the study is the limited statistical analyses included, considering that the instrument probed to collect only quantitative data.

Tuncer et al. (2005) studied the attitudes of young people in Turkey with a particular focus on the effect of school type and gender. The sample consisted of 1,497 students (765 girls, 715 boys, 17 not provide gender) attending public and private schools in Ankara. The instrument was a 45-item Likert type questionnaire consisting of four dimensions: awareness of environmental problems, national environmental problems, solutions to the problems and awareness of individual responsibility. The questionnaire was based on previous work by Worsley and Skrzypiec (1998), which was originally developed by Herrera's Questionnaire of Environmental Beliefs (Herrera, 1992). The translated questionnaire was validated by three experts in the field of science education and revisions were made on their suggestions. The revised Turkish version of the questionnaire was given to 150 students to check the internal consistency of the scale. The results were then statistically analyzed mainly through descriptive and inferential statistics including the use of two-way MANOVA (multivariate analyses of variance).

The results indicated that the environmental attitudes of young people in Turkey appeared to be positive, and young people also believed that, "Things will get much worse unless we make drastic changes in our lifestyles". The study also found out that there was a statistically significant effect of gender and school type attended on the environmental attitudes of young people in Turkey. Private school students have higher mean scores on each dimension than public school students. Similarly, girls had higher mean scores than boys on each dimension.

The results indicate that 80% of the private school respondents and 68% of the public school respondents agreed on the importance of individual responsibilities in protecting the environment. Only about 30% of the respondents support the view that environmental protection is a government responsibility.

The results indicated that the respondents' awareness levels of environmental problems were high, with about 70% believing that environmental pollution was at dangerous levels all over the world. The main environmental problems of the country were described as "the loss of biological diversity" and "population increase in the big cities".

Young people in Turkey are relatively undecided, when it comes to choosing between protection of the environment and economic growth or benefits and harmful effects of technology. In addition, the findings indicated that young people lacked trust in the solution to environmental problems offered by science and technology. The results also showed that young people in Turkey said that they were ready to accept a change in lifestyle to protect natural resources, but were unsure about how to do this.

Alp et al. (2006) made a study to determine the sixth, eighth and 10th grade students' environmental knowledge and attitudes in Turkey. The quantitative study utilized a Turkish version of CHEAKS. The sample consisted of 1,977 students from 22 randomly selected schools located in urban areas.

Results indicated that grade level has a significant effect on environmental knowledge and attitudes. Females were found to have a more positive attitude towards the environment than males. No difference in the knowledge scores was found between males and females. Through statistical analyses, it was found that

environmentally responsible behavior can be predicted by behavioral intentions, environmental affects, gender and age.

Although the age range in this study was much wider (11 to 17 years) than the current one, this study is useful because of the robustness of the statistics used and the relatively large sample. One issue with the study is the fact that although the instrument was contextualized and piloted, it addressed an audience with ages ranging from 11 to 17. Although ideal for comparative purposes, this may lead to questions that favored a particular age range of pupils. However, this study is innovative in that the analyses of the solely quantitative data, led the researchers to propose a pro-environmental behavior model, which although relatively simple, is based on empirical data.

Gambro and Switzky (1999) analyzed the distribution of knowledge about environmental issues related to energy and pollution in a national probability sample of American high school students. The data for the study was collected from the LSAY (longitudinal study of American youth), a four-year panel study that collected data from students, teachers and parents. The LSAY included a national probability sample made up of approximately 2,200 high school students. The variables examined in this study included: parental education, number of science classes taken by the student, gender and knowledge related to environmental issues. Environmental knowledge was defined as the students' score in a subscale of seven items obtained from a battery of 71 items measuring general science achievement.

These items were developed in a NAEP (national assessment of educational progress) from 1985 to 1986. They were administered to LSAY students during the Grade 12 in 1989.

The results indicated that the amount of formal education a student's parent received was significantly related to the student's level of knowledge concerning environmental issues. Only 18% of students whose parent(s) did not graduate answered at least five of the seven items correctly. About 46% of students whose parent(s) had a college degree correctly answered at least five of the seven items.

The number of science classes taken was significantly related to the students' knowledge levels of environmental issues. Approximately 22% of students who had taken one science class, 35% of those who had taken two, 44% who had taken three and 64% of those who had taken four scored satisfactorily on the criterion variable. Male students scored significantly better than female students. In fact, 44% of male students, compared to 29% of female students, had satisfactory scores on the criterion variable.

One concern of this study is the use of a relatively short (seven questions) subscale to measure environmental knowledge. The questions were concerned with energy, the greenhouse effect and acid rain, and therefore, only partially measure environmental knowledge. This is a major limitation of the study, which was acknowledged as such by the authors who believe that owing to the limitations of the measuring scale, results from this study have to be interpreted with extreme caution. In addition, the results are further weakened by a rather long 10-year gap between the actual study and the publishing of the report.

The environmental knowledge base of American high school students was researched in another study by Gambro and Switzky (1996). The sample consisted of data from the LSAY, a four-year study of students, teachers and parents. The LSAY was designed to examine the development of science and mathematics attitudes and achievement in middle school and high school students. The LSAY included a sample of 52 middle schools and 51 high schools. The subjects were selected from a national probability sample of approximately 2,900 high school students who were participating in the LSAY.

Environmental knowledge was defined through responses on a subscale of seven items, having an

eight-point scale (0 to 7), representing increasing environmental knowledge. The subscale was taken from a battery of 71 items developed for the 1985-1986 NAEP. The instrument was administered to students during their Grade 10 (1987) and Grade 12 (1989).

The seven items were grouped into two categories in order to interpret students' responses: one category was referred to as basic knowledge and included three items from the scale, while the other category required recognition of the scientific principles and application of scientific knowledge to comprehend the consequences or potential solutions to environmental problems. The majority (60% to 70%) was able to correctly answer the three basic knowledge questions, but only 42% of the students were able to answer correctly any of the four knowledge application questions. Another aspect was the rather slow growth from Grade 10 to Grade 12; only in two questions concerned with the greenhouse effect did students show substantial growth (11% and 6%).

The results indicate a weak level of environmental knowledge. For example, in Grade 12, the average student could not answer four of the seven items in the scale and only 36% of high school seniors correctly answered five or more of the items. One concern of this study is the limitations of the environmental knowledge scale which was based on only seven items.

In addition, the items only dealt with local environmental issues. Although the authors concluded that the majority of high school students have low levels of environmental knowledge and that students cannot apply the knowledge that they do have, the seven items can only provide a very narrow focus view of high school students' range of environmental knowledge and make it difficult to draw any meaningful implications.

Negev et al. (2008) conducted a national survey of Grade 6 and Grade 12 students in Israel to evaluate their environmental knowledge, attitudes and behaviors. The sample consisted of 1,591 Grade 6 students in 39 schools and 1,530 Grade 12 students in 38 schools which composed a representative national sample.

The quantitative study included a questionnaire containing four sections: environmental background information and environmental behavior; awareness, attitudes and willingness to act; knowledge and its sources and open-ended questions. Three sections consisted of Likert scale multiple choices, while one section included more open-ended questions.

Findings indicated a large range of results in the knowledge dimension especially with respect to different issues (for example, 80% of the sixth graders correctly answered questions on recycling, while only 25% successfully answered questions about the sources of global warming). Older students scored better in the knowledge test. Environmental attitudes of students were found to be positive, while the behavior scores of the sixth graders were found to be higher than those of the 12th graders. Results indicated that there is no significant correlation between knowledge and behavior, and moderate correlations between attitudes and knowledge and between attitudes and behavior. Further statistical analyses suggested that there was an interaction effect between knowledge and attitudes that influenced behavioral outcomes.

The study should be commended for the robust statistics, large sample size and the stratified sampling strategy that was used and for the grade-specific surveys. Nonetheless, concurrent qualitative analyses would have answered some of the questions more in depth.

Kuhlemeier et al. (1999) made a nationwide study in the Netherlands on youth environmental knowledge, attitudes and responsible behavior. The sample consisted of more than 9,000 students (aged 15 years) from 206 secondary schools. Of the total, 39% were higher general education students, 40% were intermediate general education students and 21% were lower vocational training students.

The environmental knowledge test consisted of 80 items which was piloted on 550 students. Each item

was a statement about an environmental problem. The test included questions on: soil, water and air-pollution, waste processing and recycling; transportation, tourism and recreation; and energy usage. The questions were spread on three regions—the Netherlands (12 items), Europe (three items) and the world (14 items). The instrument that measured attitudes included 20 Likert type statements answered in a four-point scale. The behaviour test included 20 questions that measured the degree to which students behave in environment-friendly or environment-unfriendly ways in daily life.

Results indicated that 57% of the students had a positive attitude towards the environment, and 35% said that they were prepared to make sacrifices for the environment. The findings showed that students' knowledge about environmental problems was low and fragmentary, as the knowledge of the students varied quite a bit among items. Students lacked knowledge on items, such as: energy usage; soil, air and water pollution; recycling; agricultural activities; tourism; transportation; and recreation. The average student selected the correct answer for 18 of the 30 items. With regard to environmental attitude, 57% of the students were defined as having a positive to very positive attitude towards the environment, while 42% could be classified as neutral. According to the authors, only 1% of the students had a weakly to very weakly developed (negative) environmental attitude. The mean score on the environmentally responsible behavior scale was nearly + 7 (in a scale that ranged from -20 to 20). The authors considered this to be too far beyond the centre of the scale (the score 0) to be considered as neutral, and therefore, concluded that the reported environmental behavior of the students was not "so bad after all". The relation among environmental knowledge, attitudes and behavior proved to be very weak. However, there was a significant relationship among environmental attitude, reports of willingness to make personal sacrifices and environmentally responsible behavior.

One concern about the study is that not every student was presented with each instrument. Therefore, the number of students for each combination of instruments varied from approximately 2,000 for the correlation between environmental knowledge and the remaining instruments to about 5,500 for the relation between environmental attitude and willingness to make sacrifices. On a positive note, this is one of a very few number of studies that include Europe and the world as two separate world regions. The authors should also be commended for their use of questions that focused on the reality of student life. For example, no questions were included the purchase or the use of dishwashers, tumble dryers, cars and other consumer goods that are indicative of the environmental behavior of adults. The questions focused on energy use, consumer behavior and waste production. Nonetheless, some areas of direct relevance to youth, like travel, were missing.

Kaplowitz and Levine (2005) examined the level of environmental knowledge of MSU (Michigan State University) students relative to the results of a biannual national study of the environmental knowledge of the general population of the US. The research questionnaire included specific questions on the Red Cedar River Watershed and an additional 12 "environmental knowledge" questions that were taken from the NEETF (National Environmental Education and Training Foundation) and Roper Starch Worldwide (Roper) survey of adult Americans. The final research instrument included a total of 56 items which were grouped into 10 separate sections.

The sample included 19,890 students which were randomly selected through stratified sampling from the 44,000 students enrolled at the university. Because of financial constraints, about 17,000 students received the questionnaire through the Web rather than receiving a conventional hard copy. The response rate for the questionnaires was 32% for the postal questionnaire and 21% for the Web-based questionnaire.

The results indicate that MSU students on average answered 74% of the knowledge questions correctly.

The items most often answered correctly concerned the students' knowledge that batteries were a hazardous waste (88% correct) and biodiversity correct (86%). The questions in which the students answered least correctly concerned electricity generation (56% correct) and non-point sources of pollution (44% correct). The data also indicate that MSU students are significantly more knowledgeable in environmental issues than the average American adult. For example, 66% of MSU students received acceptable scores on the environmental knowledge items compared to 32% of the national sample. The research also indicated differences in environmental knowledge among different colleges of the university. The college of medicine, the college of agriculture and the college of natural resources and sciences scored highly on the average number of items passed. Below average results were recorded by the college of education, the college of nursing and the college of human ecology. Owing to the relatively low level of environmental knowledge in MSU students in the college of education, the authors suggested more research to find means of increasing the level of environmental knowledge of tomorrow's teachers.

This study should be commended for the large sample which makes it possible to generalize about certain research findings. On the other hand, there was no reported questionnaire piloting and this seems to be a serious omission, as the students were asked to complete a Web-based or a postal questionnaire, and therefore, could not ask for clarification of particular questions. The response rate for the questionnaires was 32% for the postal questionnaire and 21% for the Web-based questionnaire. The relatively low response rate may have also skewed the stratified sampling technique towards a particular group of students. In addition, the relatively short environmental knowledge subscale had a strong emphasis on local/ national environmental issues.

Analysis and Conclusions

In summary, the majority of the studies reviewed in this first part of the literature review used a quantitative technique to gather data. Only the Sivek's (2002) study utilized a qualitative technique (focus groups) to gather data. Korhonen and Lappalainen's (2004) study and Hampel, Holdsworth, and Boldero's (1996) study used a combination of qualitative and quantitative methods, though the studies were mostly quantitative in nature. Most studies were directly concerned with high school students, and few studies with the exception of Mogenson and Nielsen (2001), making explicit comparisons among different age groups. The geographic distribution of the studies mainly included studies from the USA and Europe. However, there were other studies from Africa, Asia and Australia, so the five main continents were all represented. Table 2 summarizes the methodologies of the studies.

The findings of a majority of studies reported a positive attitude towards the environment. Studies reported a variety of levels of environmental knowledge. Studies generally reported weak levels of environmental knowledge (Kuhlemeier et al., 1999; Gambro & Switzky, 1996; Makki et al., 2003), while others reported high levels of environmental knowledge (Ivy et al., 1998; Kaplowitz & Levine, 2005; Korhonen & Lappalainen, 2004). Behavior was not extensively studied, although studies like the Negev et al.'s (2008) also attempted to draw out relations of behavior with knowledge and attitude.

A number of studies found that females had a more positive attitude towards the environment than males (Alp et al., 2006), while studies like the one by Salmivalli (1998) indicated significant differences between the attitudes of boys and girls, in particular attitude traits. The results in the Tuncer et al.'s (2005) study indicated that there was a statistically significant effect of gender and school type attended on the environmental attitudes of young people in Turkey, with girls having higher means scores than boys in each dimension.

Table 2

Synopsis of Methodologies

Author	Methodology
Alp et al. (2006)	The quantitative study utilized a Turkish version of CHEAKS. The sample consisted of 1,977 students from 22 randomly selected schools located in urban areas.
Barrett and Kuroda (2002)	The quantitative instrument included 12 statements that reflect the criteria established under the NEP.
Bradley et al. (1999)	Environmental knowledge and attitudes were assessed from a questionnaire administered before and after exposure to a ten-day environmental science course. The quantitative instrument included 18 multiple-choice questions for the knowledge section and 15 questions in a Likert type scale for the attitude section.
Eagles and Demare (1999)	The questionnaire includes eight personal information questions and 30 environmental attitude questions. Pre-test questionnaire one week before participation in camp program, followed by an identical post-test questionnaire.
Gambro and Switzky (1996)	The sample consisted of data from the LSAY. The subscale was taken from a battery of 71 items developed for the 1985-1986 NAEP.
Gambro and Switzky (1999)	The data for the study was collected from the LSAY. Environmental knowledge was defined as the students' score on a subscale of seven items obtained from a battery of 71 items measuring general science achievement.
Gigliotti (1994)	The quantitative study included a 12-page, self-administered and mail-back questionnaire to 1,500 first years Cornell University randomly selected students (70% returned).
Hampel et al. (1996)	The instrument was piloted and comprised an 18-item environmental attitude/belief scale; a 20-item knowledge scale, a five-item environmental behavior scale and a ranking of 10 issues of most concern. Followed by interviews with highest/lowest scoring individuals.
Hodgkinson and Innes (2001)	The study involved a sample of 391 students in their first semester of study. They completed two instruments—The NEP Scale and the EAS.
Ivy et al. (1998)	A survey questionnaire of 55 items was grouped in four sections: understanding and knowledge, attitude towards the environment, frequency of environmental tasks performed and perception of environmental problems.
Kaplowitz and Levine (2005)	The research questionnaire included specific questions on the Red Cedar River Watershed and an additional 12 "environmental knowledge" questions that were taken from the NEETF. The final research instrument included a total of 56 items which were grouped into 10 separate sections.
Korhonen and Lappalainen (2004)	Information was collected using semi-structured questionnaires in primary and middle schools, and open questionnaires in secondary schools.
Kuhlemeier et al. (1999)	The environmental knowledge test consisted of 80 items which was piloted on 550 students. The questions were spread on three regions—the Netherlands (12 items), Europe (three items) and the world (14 items). The instrument that measured attitudes included 20 Likert type statements and the behavior test included 20 questions.
Makki et al. (2003)	The research instrument was a two-part questionnaire to assess participants' environmental knowledge (34 multiple choice items) and attitudes (28 four-point Likert type items). Some of the questions were adapted from the CHEAKS and some questions were developed for this study.
Mogenson, and Nielsen, (2001)	The quantitative study involved the use of a seven-page questionnaire containing 29 open and closed questions.
Negev et al. (2008)	The study included a questionnaire containing four sections: environmental background information and environmental behavior; awareness, attitudes and willingness to act; knowledge and its sources and open-ended questions. Three sections consisted of Likert scale multiple choices, while one section included more open-ended questions.
Pawlawski, (1996)	The research instrument was a 20-item questionnaire which was pre-tested to exclude unintelligible questions.
Said et al. (2007)	The quantitative study examined 306 students. The instrument included sections on demography, sources of environmental information, concept of environment, environmental knowledge, environmental awareness and concern, sustainable consumption behaviors and nature-related activities.
Salmivalli (1998)	The quantitative study included two instruments: CER1—185 questions with a five-point Likert type answer scale; and DTT which involves the use of an image of the future that helps discover what things are of value to a child.
Sivek (2002)	The study mainly used qualitative methods. Phase 1 employed a qualitative methodology with a focus group design (two groups of six females and two groups of four males). Phase 2 employed a paper survey which mainly collected demographic data.
Tuncer et al. (2005)	The quantitative study included a 45-item Likert type questionnaire consisting of four dimensions: awareness of environmental problems, national environmental problems, solutions to the problems, and awareness of individual responsibility.

In the study by Gambro and Switzky (1999), male students scored significantly better in their knowledge scores than female students, while in the study by Alp et al. (2006), results indicated no difference between such scores.

Bradley et al.'s (1999) study found that students having higher knowledge scores had more favorable environmental attitudes. In the study by Gambro and Switzky (1999), the amount of formal education a student's parent received was significantly related to the student's level of knowledge concerning environmental issues. Makki et al.'s (2003) study found that participants with "more educated" fathers had significantly higher environmental knowledge scores, while there was no significant relationship between the mother's educational level and the participants' environmental knowledge scores in the same study. In Salmivalli's (1998) study, no statistically significant difference was found among age groups with regard to environmental attitudes.

The results indicated that the main sources of environmental information for Japanese youth were television, newspapers, school and friends (Barrett & Kuroda, 2002). Ivy et al. (1998) found that the main sources of environmental information mentioned by students were newspapers, books and magazines, general education at school, and radio and TV. In Said et al.'s (2007) study, results showed that mass media, especially TV, were the main suppliers of environmental information. Pawlowski (1996) indicated that the main sources of information were TV and newspapers. It is evident that the mass media are the main suppliers of environmental information. Other emerging media like the Internet will probably feature more prominently in future studies as some of these studies collected data in the early days of Internet availability.

The main environmental problems mentioned by students were air pollution, water pollution and noise (Said et al., 2007), the "loss of biological diversity" and "population increase in the big cities" (Tuncer et al., 2005), hazardous waste and improvement of air quality (Gigliotti, 1994) and pollution (Mogenson & Nielsen, 2001).

Few studies attempted to statistically correlate data. Hampel et al.'s (1996) study found an almost linear relationship among the school rankings by SES and the combined score on the attitude, knowledge and behavior scales. As SES increased, the combined score increased as well. Results in Negev et al.'s (2008) study indicate that there is no significant correlation between knowledge and behavior, and moderate correlations between attitudes and knowledge and between attitudes and behavior.

Most studies used quantitative techniques to gather data. The most commonly used instrument was a questionnaire with multiple choice questions and a Likert-type scale particularly to measure attitudes. Nonetheless, some of the instruments used to collect data had a number of limitations. The instrument used by Gambro and Switzky (1996) and Gambro and Switzky (1999) was too brief and narrowly focused, as it included only seven questions, while the instrument used by Kaplowitz and Levine (2005) had a relatively short environmental knowledge sub-scale with a strong emphasis on local/ national environmental issues.

A number of studies relied on previously existing instruments, some of which have been given particular names including the NEP Scale and the CERI. Some of these studies (for example, Barrett & Kuroda, 2002) did not properly address some of the shortcomings of such scales, while others simply adopted the scale without contextualizing it in their own particular region. A number of studies included instruments which were made and piloted in the context that they were intended to measure, such as the study by Kuhlemeier et al. (1999). Such instruments are arguably better suited to study different regions than "A one size fits all approach" adopted by other studies, especially because of questions that actually reflect the reality of student life and context.

Some studies utilized robust statistics and an appropriate sample size, such as the study by Alp et al. (2006)

and the study by Makki et al. (2003). However, a number of studies had a number of limitations in their sampling strategy or statistical analyses. The study by Eagles and Demare (1999) utilized methodology which does not really allow findings to be verified especially, since they did not include a control group. A number of studies did not use an appropriate sample size, such as Eagles and Demare (1999). Tuncer et al.'s (2005) study included the use of robust statistics, but the instrument mainly measured attitudes and was concerned with national issues and problems. Some studies, such as the study by Ivy et al. (1998), included appropriate sampling procedures and a good sample size but then included only limited statistical analysis. The study by Sivek (2002) utilized sampling strategies which may introduce bias, while in the research by Hampel et al. (1996), the interview sample was drawn from the highest and lowest score on the screening test, and therefore, this increases the possible effect of regression towards the mean.

Considering the mainly quantitative nature of these studies, more appropriate sampling strategies, contextualized research instruments and statistical analysis should have been carried out to ensure more robust statistical findings. It is also apparent that a number of shortcomings of these studies could have been addressed through the addition of at least some open-ended questions or the addition of a qualitative study that would have addressed the reasoning behind the choices made by students.

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