A Novel Approach to Deepen Understanding of Undergraduates' Environmental Backgrounds

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Universities often lack a detailed understanding of the environmental backgrounds of their students. One way to improve understanding is through segmentation, which breaks down a population into groups of people with similar characteristics. This study aims to use segmentation to determine groups within the student population, based on environmental attitudes, and compare these groups in terms of environmental knowledge, activities, information sources and demographic characteristics. This study of undergraduate students identified six groups, with varying levels of support for the New Environmental Paradigm (NEP). Factor scores varied among groups with similar NEP scores. Student groups with high NEP scores used more information sources, participated in more environment-friendly activities and were more likely to be female than those with low scores. Environmental knowledge using four indicators was not significantly correlated to attitude groups. The most used information sources were from various electronic and print media.

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Introduction

Intensifying environmental problems require solutions developed by environmentally aware, concerned and active citizens (Holl *et al.*, 1999). Universities are one of the many institutions that assist in educating such citizens (Wilke, 1995). Ideally, environmental education at universities would be woven into the fabric of the learning experience across many disciplines (Orr, 1992; Strauss, 1995). To some extent, this broad weaving occurs in the context of interdisciplinary design and environmental issues are often targeted in two specific delivery areas (Brough, 1992).

First, some universities (or faculties or departments therein) require that all students, whatever their major, take one or more environment-related courses during their studies (Wilke, 1995). There is evidence that required environment-related courses make a positive improvement in environmental knowledge, attitudes, intentions and behaviour (Benton, 1993; Bradley *et al.*, 1999; Kinsey & Wheatley, 1984; Mangas *et al.*, 1997; Smith-Sebasto, 1995), but opinions are varied about whether these changes are spurious, sufficient, or lasting (Benton, 1993; Strauss, 1995; Zelezny, 1999). Relevant issues in this debate include the style of teaching (Lord, 1999; Maniates, 1993; Orr, 1990) and course setting (Zelezny, 1999).

Second, many universities address environmental issues by offering related programs, mostly in environmental science and environmental studies, but also in other areas such as environmental health, engineering and conservation (Romero & Jones, 2003; Soulé & Press, 1998; Weis, 1990). Most of these programs have been established in the last 15–20 years (McGowan, 2004; Strauss, 1995).

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Most environmental programs and courses were developed with little knowledge of the types of students who would be involved and the level of variability of their environmental backgrounds. The lack of detailed understanding of the environmental backgrounds of these students reduces the potential for effective planning and delivery of these courses and programs. A method to increase understanding of the environmental backgrounds of undergraduate students is through segmentation (Rogers *et al.*, 2001). Segmentation has been used widely in consumer marketing research (e.g. Freeman & Lessiter, 2003; Machauer & Morgner, 2000; Moriarty & Reibstein, 1986). Segmentation simply breaks down a population into groups of people which have similar characteristics and can provide valuable understanding of the needs, motivations and other relevant characteristics of these groups (Rogers *et al.*, 2001). Any organisation can segment its clients to gain several benefits (Rogers *et al.*, 2001). Segmentation studies can help focus energy on target groups, assess needs not being addressed currently, design new programs and services to meet those needs and monitor changes in groups over time.

Segmentation practices have considerable value for colleges and universities (Rogers *et al.*, 2001; Rowley *et al.*, 1997). Although not used widely (Rogers *et al.*, 2001), institutions of higher education have applied segmentation techniques primarily to assess student markets (Klein *et al.*, 2001; Leister & MacLachlan, 1976) and to address student needs (Absher & Crawford, 1996). Exploratory studies tend to use demographic characteristics for segmentation, but more sophisticated models use other psychographic and behavioural variables, such as learner needs and attitudes (Machauer & Morgner, 2000; Rowley *et al.*, 1997; Urbonavicius & Kasnauskiene, 2005). In environmental education studies, attitudes are a key determinant of environment-friendly intentions and behaviours (Bradley *et al.*, 1999; Hines *et al.*, 1987), and thus can be helpful in segmenting students.

Thus, the general purpose of this study is to employ a segmentation approach to environmental education in the context of higher education. The specific purpose is to use segmentation to determine groups within the student population, based on environmental attitudes and compare these groups in terms of environmental knowledge, activities, information sources and demographic characteristics.

Methodology

The research study took place during the fall of 1998 and 1999 at the University of Alberta's Augustana Campus in Camrose. Using convenience sampling, students enrolled in 13 different courses from a variety of disciplines were asked to complete questionnaires during the beginning of the regular class periods. To avoid duplicate responses by students who were taking more than one of the

courses sampled, students who had already completed the questionnaire were excused. The questionnaire took 5–10 minutes to complete. Ethics approval was received for research on human subjects.

Questions asked students about their environmental knowledge, information sources, activities, attitudes and demographic characteristics. Where possible, questions were worded to be consistent with previous research efforts. First, environmental attitudes have been measured using many scales (see Schindler, 1999), but this study employed a modified New Environmental Paradigm (NEP) Scale, developed by Dunlap and Van Liere (1978), with a 5-point Likert scale (see Table 1). The study added four new items related to generational, ethical and perceptual issues, which were lacking in the NEP scale (see new proposed changes to the NEP scale – Dunlap *et al.*, 2000). Some questions were worded so that respondents with consistent attitudes would vary in the direction of agreement or disagreement. Later analyses re-coded the responses so that agreement always indicated support for the NEP. Second, nine information source options were listed, as adapted from other studies (Hausbeck *et al.*, 1992; Holl *et al.*, 1999; Ivy *et al.*, 1998). Third, measures of knowledge about the environment and sustainability are very situation-specific and time-specific, and thus have not been consistently applied (e.g. Bradley *et al.*, 1999; Gambro & Switzky, 1996; Kuhlemeier *et al.*, 1999). For this study, environmental knowledge questions were similar to Meffe's (1994) and Dunning's (1997) questions about current human population, rate of population growth, number of species on earth and rate of species extinction. Fourth, nine environment-friendly activity options were listed, as adapted from other studies (e.g. Tarrant & Green, 1999) and placed in the context of students at Augustana. Finally, four demographic variables were measured: year status at university, major, age and gender.

Segmentation involved the following procedure. Even though most researchers use summed NEP scale for analyses (e.g. Dunlap & Van Liere, 1978), Noe and Snow (1990) advise caution in assuming that this procedure will work for all sample populations. Similarly, Geller and Lasley (1985) caution researchers against placing attitude questions into pre-selected attitude components. Factor analysis is commonly used to identify key factors that can be used to differentiate groups within a data set (e.g. Absher & Crawford, 1996; Klein *et al.*, 2001; Rogers *et al.*, 2001). Thus, in this study, a principal components factor analysis was conducted on the attitudinal scale, using the varimax raw rotation method to determine unrelated factors to explain differences among the attitude statements. Components with an eigenvalue over 1.0 were included. For cases with missing values (7.1%), variable means were substituted. Then, based on the sum of factor scores within each component, a cluster analysis was used to segment students into groups. The process used K-means clustering with initial cluster centres chosen to maximise initial between-cluster distances. The number of clusters was increased from two until a cluster had less than 5% of the entire sample. Internal consistency was tested with the Cronbach's alpha score.

Subsequent analyses compared groups on the basis of attitude scores (partial score by each factor and the total NEP scale), information sources (total number used), knowledge (correct responses to each question and total number of correct responses), environmental-friendly activities (total number). Comparisons used chi-square analyses, Pearson product-moment correlations, coefficients of

Table 1 Factor loadings for each statement by factor

<i>Statement (Responses coded originally as Strongly Agree = 1, Agree = 2, No Opinion or Unsure = 3, Disagree = 4, Strongly Disagree = 5)</i>	<i>Factor loading scores</i>		
	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>
We are approaching the limit of the number of people the earth can support	0.633	0.155	0.196
To maintain a healthy economy, we will have to develop a steady-state economy where industrial growth is controlled	0.596	−0.023	0.089
The earth is like a spaceship with only limited room and resources	0.676	0.055	0.227
There are limits to growth beyond which our industrialised society cannot expand	0.672	0.086	−0.073
Humans have the right to modify the natural environment to suit their own needs ¹	0.157	0.668	0.073
Plants and animals exist primarily to be used by humans ¹	0.059	0.769	−0.003
It is everyone's right to create as much garbage as he or she wants ^{1,2}	0.143	0.478	0.242
Humans are destined to rule over the rest of nature ¹	0.016	0.749	0.000
Humans need not adapt to the natural environment because they can remake it to suit their needs ¹	−0.052	0.474	0.312
Environmental problems are exaggerated by environmentalists ^{1,2}	0.100	0.377	0.373
The balance of nature is very delicate and easily upset	0.051	0.061	0.512
When humans interfere with nature, they often produce disastrous consequences	0.118	−0.037	0.688
Humans must live in harmony with nature in order to survive	0.099	0.096	0.615
Humans are severely abusing the environment	0.384	0.120	0.479
Actions to reduce pollution should not be left to future generations ²	0.226	0.100	0.430
There is no need to conserve natural resources because they will not be exhausted in my lifetime ^{1,2}	0.270	0.328	0.392
Eigenvalue	3.68	1.67	1.13
Variance explained	23.0%	10.5%	7.1%

¹Indicates that this statement was reverse coded before analysis.

²Indicates a statement added to the scale of Dunlap and Van Liere (1978).

determination and one-way analyses of variance. For the latter, post-hoc comparison of means used Tukey's honestly significant difference test. The level of significance was set at 0.05.

Some limitations to this study should be noted. First, because the attitude scale is multidimensional in nature, this study cannot determine if all of the possible dimensions are represented by the 16 attitude statements. Second, the knowledge questions, although representing important issues, may not be representative of a student's broader grasp of environmental issues. Third, the information sources represented most of the possibilities, but this study did not determine how well these sources were used or what type of information was used from each source. Fourth, the action questions assumed an equal opportunity for participation by respondents and an equal significance among actions. Fifth, studies have shown differences between self-reported versus actual behaviour (Hines *et al.*, 1987).

Results

A total of 548 students completed the questionnaire. The response rate was 89.5%. The sample's demographic characteristics were generally representative of the entire student body on campus. In the sample, 63.4% of respondents were females, slightly higher than the campus rate of 58.9%. In the sample, 83.6% were first- and second-year students, slightly higher than the campus rate of 71.6%. The distribution of students by program in the sample (36.7% from social sciences, 27.9% from sciences, 9.3% from humanities, 9.3% from physical education, 6.2% from fine arts and 10.6% undeclared) was fairly consistent with that of the entire student body.

Students were segmented on the basis of environmental attitudes. Using principal components analysis on all 16 re-coded attitude statements, three factors had an eigenvalue greater than 1.0 (Table 1). The first group of statements, which loaded highest on factor 1, all related to limits to growth. The second group of statements, which loaded highest on factor 2, related mostly to humans over nature. The third group of statements, which loaded highest on factor 3, related mostly to the balance of nature. A total of 40.5% of the variance was explained by using these three factors. The average partial NEP score was 8.8 for the limits to growth factor ($SD = 2.47$), 13.0 for the humans over nature factor ($SD = 3.68$) and 10.9 for the balance of nature factor ($SD = 3.09$).

The second step in the process used cluster analysis of the factor scores to produce six groups of respondents. Six iterations were required to finalise the clustering process (Table 2). Cluster 1 had the most pro-environment attitudes, scoring the lowest (NEP score of 24.3) on all factors. Clusters 2, 3 and 4 all had moderate attitudes (NEP scores from 32 to 34), but of these three groups, cluster 2 scored especially high on the limits to growth factor, cluster 3 scored high on the balance of nature factor, and cluster 4 scored high on the humans over nature factor. Finally, clusters 5 and 6 both had relatively negative attitudes (NEP scores of about 45), but cluster 5 scored high on the balance of nature factor, while cluster 6 scored high on the limits to growth factor.

The NEP could range from 16 to 80, with a mid-point of 48. A low score indicates pro-environment attitudes and a high score indicates the opposite.

Table 2 Factor differences by cluster

<i>Cluster (n,%)</i>	<i>Partial NEP scores (adding statements comprising each factor)</i>	<i>Total NEP score</i>		
	<i>Factor 1: Limits to growth</i>	<i>Factor 2: Humans over nature</i>	<i>Factor 3: Balance of nature</i>	
	<i>(Cluster significantly different from other clusters listed in brackets)</i>			
1 (115, 21.0%)	6.3 (all)	9.7 (all)	8.3 (all)	24.3 (all)
2 (116, 21.2%)	10.9 (all)	10.9 (all)	10.3 (all)	32.1 (1,3,5,6)
3 (129, 23.5%)	8.6 (1,2,5,6)	12.6 (all)	13.1 (all)	34.3 (1,2,5,6)
4 (121, 22.1%)	8.0 (1,2,5,6)	15.8 (1,2,3)	9.2 (all)	33.0 (1,5,6)
5 (31, 5.7%)	9.7 (all)	18.7 (1,2,3,4)	15.9 (all)	44.8 (1,2,3,4)
6 (36, 6.6%)	13.1 (all)	17.5 (1,2,3,4)	14.3 (all)	45.0 (1,2,3,4)
Average	8.8	13	10.9	32.6
Cronbach's alpha	0.60	0.69	0.61	0.78
Statistics	$F = 154.6$	$F = 154.1$	$F = 142.7$	$F = 200.7$
	$df = 5$	$df = 5$	$df = 5$	$df = 5$
	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$

The average score was 32.6 (SD = 7.08; Table 2). For every question, over half of the respondents supported the NEP. Cronbach's alpha for the entire set of NEP items was 0.78.

The average number of information sources used was 4.3 (range = 0–10, SD = 1.57). The television was the most used (92%) source, followed by the newspaper (79%), magazines (63%), radio (58%), family and friends (42%), university (35%), books (25%), internet (18%) and environmental groups (13%). The number of sources was not correlated with the limits to growth, but was correlated with the humans over nature factor ($r^2 = -0.15$, $p = 0.001$) and balance of nature factor ($r^2 = -0.10$, $p = 0.034$).

Four knowledge questions were used. After deleting significant outliers and providing a generous range of 'correct answers' (see Dunning, 1997; Meffe, 1994), 41.6% of respondents were correct on the human population question, 9.7% on rate of population growth, 26.0% on number of species on earth and 7.2% on the rate of species extinction. Only one factor score differed by knowledge level. Students answering the population question correctly had a higher humans over nature factor score (13.5) than students answering this question incorrectly (12.6, $F = 5.9$, $p = 0.015$). Similarly, students answering the total species question correctly had a higher humans over nature factor score (13.5) than students answering this question incorrectly (12.6, $F = 4.0$, $p = 0.047$).

Table 3 Differences by cluster for information sources, environmental-friendly activities and gender

Cluster	Number of information sources	Number of environment-friendly activities	Gender (m/f)
	<i>(Cluster is significantly different from other clusters listed in brackets)</i>		
1	4.6 (none)	4.6 (3,4,5)	26.1/73.9
2	4.6 (4)	4.6 (3,4,5)	24.1/75.9
3	4.2 (none)	3.9 (1,2,5)	36.4/63.6
4	4.0 (2)	3.8 (1,2)	49.6/50.4
5	3.8 (none)	2.5 (1,2,3)	54.8/45.2
6	4.1 (none)	3.5 (1,2,3)	52.8/47.2
Average	4.3	4.1	36.6/63.4
Statistics	$F = 3.5$	$F = 11.1$	$X^2 = 30.4$
	$df = 5$	$df = 5$	$df = 5$
	$p = 0.004$	$p < 0.001$	$p < 0.001$

Respondents participated in an average of 4.1 environment-friendly activities (range = 0–9; SD = 1.79). The most common activities were donating unwanted items to charity (77%), using the backside of writing paper (72%), participating in a recycling program (63%) and avoiding products with lots of packaging (56%). The number of activities was not correlated with the limits to growth factor, but was correlated with the humans over nature factor ($r^2 = -0.29$, $p < 0.001$) and balance of nature factor ($r^2 = -0.27$, $p < 0.001$). The coefficients of determination may indicate statistically significant relationships in these analyses due to the sample size, but practically speaking, the significance may be minimal. Nevertheless, in these cases, 27–29% of the variance in the number of environmental-friendly activities is explained by the individual factor scores.

The clusters were compared on the basis of information sources, knowledge and activities (Table 3). Clusters 1 and 2 used the highest number of information sources and cluster 5 used the lowest number. However, significant differences were found only for clusters 2 and 4. Clusters were not different regarding correct responses to the knowledge questions. Clusters 1 and 2 engaged in the highest number of environmental activities and cluster 5 engaged in the lowest number.

In terms of demographic variables, the clusters did not vary by age, year status, or program, but did vary by gender (Table 3). Clusters 1 and 2 were over represented by females and clusters 5 and 6 were over represented by males.

Discussion

Several features of this study should be highlighted. First, the students' environmental background is similar to studies of other student populations. The most used information sources were primarily from various electronic and print

media, as was also found by Holl *et al.* (1999). Knowing the heavy dependence on television, magazines and radio will help instructors address issues about information quality and access. The rate of correct answers on knowledge questions was similar for students at Stanford University (Holl *et al.*, 1999) and Purdue University (Dunning, 1997) for the key issues of population and species extinctions. The relatively low level of knowledge suggests that more attention should be given to these trends, their significance and interactions with other global variables. The rate of participation in environmental-friendly behaviour was similar to national studies of Canadians (Parks Canada, 1993; Statistics Canada, 1995). Thus, overall this sample has a similar environmental background to other comparable groups.

Second, the analysis of student attitudes was useful in determining the relative sizes of student groups with different environmental attitudes. The factor and cluster analysis procedures produced six student groups, based on differences in their environmental attitudes. Relative to the others, one student group (accounting for 21% of all respondents) had the most pro-environment attitudes, three groups (67%) had moderate attitudes and two groups (12%) had the least pro-environment attitudes. However, even the last two groups had a total NEP score lower than the mid-point of 48. Thus, based on attitudes, there are more similarities than differences among these groups.

The distribution of student groups, based on attitudes, is relevant for a few reasons. First, instructors of environment-related courses could expect the moderate group, by virtue of their size, to dominate classroom discussion. Instructors should be careful to include the smaller groups on either end of the attitude continuum. In classroom situations, debate and discussion can be enlivened if these groups can be coaxed into describing their contrasting views (McKeachie, 1994). Second, it is useful to acknowledge and build upon, the spectrum of attitudes already present, rather than forcing a consideration of views not present. Third, even among clusters 2, 3 and 4 with similar total NEP scores, there was much variation in the three factors that made up those total scores.

Third, specific components of environmental attitudes were important in defining groups of students. Other studies (Albrecht *et al.*, 1982; Geller & Lasley, 1985) also found three factors, with essentially the same statements loading within each factor as this study. This study also found that some groups with similar NEP scores had differences in specific factor scores. The humans over nature score ranged more than the other two factors, suggesting that a wider spectrum of attitudes in this area should be considered in teaching plans.

Components addressing humans over nature and balance of nature were more correlated to environmental behaviour than the limits to growth component. However, Corral-Verdugo and Armendáriz (2000) found that the limits to growth component of the NEP scale were most important in predicting pro-environment behaviour. Similarly, Scott and Willits (1994) found that the combined limits to growth and balance of nature components were more correlated to environmental-friendly consumer behaviour than the humans over nature component.

Fourth, this study found that groups of students with positive environmental attitudes used more information sources and engaged in more environment-friendly activities. Other studies have shown that pro-environment attitudes

have positive, but weak correlations with pro-environment behaviour (Dunlap & Van Liere, 1978; Gigliotti, 1994; Kuhn & Jackson, 1989; Scott & Willits, 1994; Shanahan *et al.*, 1999). Environmental instructors should recognise these interactions and build upon them. Even though a positive correlation between environmental attitudes and knowledge was found by others (Kuhlemeier *et al.*, 1999; Synodinos, 1990), this study found no correlation. This may reflect the specific questions chosen for this study, related to population and species. No other studies tested similar correlations for information sources.

Finally, student groups with scores supportive of the NEP were more likely to be female than male. Recent reviews also show that females have more pro-environment attitudes than males (Kalof *et al.*, 2002), with a few inconsistent results (Scott & Willits, 1994). In most other studies, pro-environment attitudes are negatively correlated with age and are positively correlated with education (Arcury, 1990; Scott & Willits, 1994; Van Liere & Dunlap, 1980), but a few studies show no correlation with education (Uysal *et al.*, 1994), as was found here.

In conclusion, a segmentation approach based on environmental attitudes can improve our understanding of students, and can illustrate important differences among and within groups. The NEP scale and segmentation approach has been used widely to derive student groupings and can be implemented in the classroom context. This student sample was generally pro-environment, according to the NEP scale. Groups that were more supportive of the NEP (lower scores) used more information sources, participated in more environmental-friendly activities and contained more females than groups that were less supportive of the NEP (higher scores). As well, some specific factors correlated with environmental-friendly activities.

A number of future research items are suggested. Student group sizes and the composition of factors by attitude statements should be compared with those from different academic settings. The correlation between the environmental attitude factors and use of information sources, environmental-friendly behaviour and demographic variables should be examined in more detail. Future research should also examine the depth to which students use information and engage in environmental-friendly behaviour, along with how well their self-reported behaviour matches with actual behaviour.

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Queries

- Q1: Author: The year “2001” has been changed to “2000” in the textual reference “Machauer & Morgner, 2001” to match with the reference in the list. Please check.
- Q2: Author: Please check the running title for appropriateness.