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Factors Leading to the Selection of an Undergraduate Environmental Science Major

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Abstract—In spite of increased environmental awareness among American millennials, environmental problems are escalating. The solution to today's environmental problems can be achieved *in part* by training more environmental scientists in our colleges and universities. A mixed-methods approach is employed to better understand why students at the University of Tennessee at Chattanooga select environmental science as a major. Once the factors that contribute to and support a student's decision to select environmental science are revealed, a preliminary supposition is generated to explain the phenomenon. Ultimately, it is determined that while both practical and affective concerns are important, the most important factor in selecting environmental science as a major is the potential for finding a job in the field. Recommendations and implications are included and explicated.

Introduction

Environmental issues attract much attention in the popular media, with American millennials more environmentally aware than previous generations (Pew Research Center, 2011). Even so, as human use of the environment escalates and as technological interactions with the natural world increase, habitats are still being degraded and destroyed, and the capacity of ecosystems to function continue to be compromised. Deforestation and resource depletion remain causes for concern, as are the pollutants and toxicants that contaminate waterways and the urban-industrial discharges that threaten the integrity of air and the stability of Earth's climate (Raven et al., 2015). Although it is comforting to know that American millennials are now more aware, increased awareness by itself does not represent a solution to the complex environmental problems that plague the modern world. One partial solution is to produce more formally trained environmental scientists in our colleges and universities, scientists who will be well equipped to meet the environmental challenges of the future (University of Ulster, 2007). Kevin Doyle (2008), president of Green Economy, points out that we "need environmental professionals to work at our environmental agencies, companies, advocacy groups, and consulting firms" (Educating Environmental Professionals in the Sustainability Era section, para. 9). Doyle (2008) believes in the importance of training "a new kind of 'sustainability' professional who [can] develop environmental solutions that simultaneously advance social and economic goals" (para. 2). In short, more broadly-trained environmental scientists are needed to help bring about lasting environmental change. Fortunately, impassioned faculty and staff at institutions of higher learning have been working diligently in recent years to advance the field of environmental science (ESC) as a discipline and as a career choice. This is especially true at the University of Tennessee at Chattanooga (UTC), a medium-sized, metropolitan university located in East Tennessee.

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This mixed-methods preliminary study grows out of a legitimate need imbedded in the primary researcher's position as Undergraduate Environmental Science Coordinator in the UTC Department of Biology, Geology, and Environmental Science. For almost a decade, undergraduate ESC enrollment at UTC was on the decline. Over the last ten years, however, that trend has reversed. Although faculty are excited by the great number of students wanting to select ESC as a major, the reason why students now want to make such a selection has proved elusive. The purpose of this preliminary study is to determine factors that contribute to and support an undergraduate student's decision to select environmental science as a major. A greater understanding of what prompts undergraduates to select environmental science might help ensure the recent increases in undergraduate ESC enrollment continue. Such information might even help educators at institutions other than UTC more effectively market and reinvigorate struggling ESC programs. It should be noted that one factor that could be used to help reinvigorate struggling ESC programs (from a marketing standpoint) is that the job outlook for environmental science from 2016 through 2026, as reported by the US Department of Labor's Bureau of Labor Statistics (2018), is 11 percent. This is considered faster than average and could possibly be contributing to the growth we have seen in UTC's ESC program.

The research questions for this mixed-methods study are as follows: for the qualitative portion: (1) what influence do personal values have on the selection of ESC? (2) What influence does experience with ESC classes and/or ESC professors have on the decision to select and/or remain in environmental science? (3) What other factors might ESC majors reveal as having influenced their decision? Questions for the quantitative portion are as follows: (4) which factors are most important to an ESC major: practical concerns (job prospects, monetary payback, etc.) or less tangible, more affective concerns (psychological benefits, social benefits, level of interest, etc.)? (5) How do ESC majors differ from non-ESC majors in terms of the importance of the various factors?

Literature Review

It is possible that exposure to technology could play a role in the selection of a STEM-based major like environmental science. Lee (2015) conducted a careful investigation of the relationship between technology-based activities and student selection of a STEM major. Lee's study suggests that using and promoting technology is a significant factor in motivating students to select a STEM-based major and career. Student preparation could also play a role. It was determined by Gaalswyk et al. (2014) that students that had selected STEM-related majors at Iowa State University had more credits in calculus, chemistry, and environmental science. The authors report that academic preparation was a significant predictor of a transfer student's choice to select a STEM-based major.

Cebula and Lopes (1982) assume that, when selecting a major, students focus on the earning potential of graduates in that field, future job outlook, the inherent difficulty of the material that must be mastered, and the overall quality and atmosphere of the department that provides instruction within that field. Although the researchers assumed that the selection of a major would be related to a variety of factors, they determined that it depended mostly on factors of a certain type, namely those factors related to *expected future earnings*. Beggs et al. (2008) focused primarily on psychological processes and showed that while functional concerns (related to job prospects, financial considerations, fit and interest, etc.) continue to be important, of at least some importance are the psychological and social benefits of selecting a major. After identifying factors undergraduates view as important when selecting a major, Beggs et al. (2008) used a quantitative approach whereby students ranked these factors in importance from greatest to least. A matching of the major with personal interests was the most important for the students with psychological and social benefits, and even financial success ranked lower than expected (Beggs et al., 2008). These results are in marked contrast to the Cebula and Lopes (1982) study and suggest that while financial considerations are important, the possibility exists that factors other than financial considerations could also play a significant role. Senn (1984) used a self-report questionnaire and found that those students who were actively pursuing the major they wanted to pursue had a much higher self-concept than other students, suggesting that personal values and overall self-concept influence the selection of an academic major. Umarji et al. (2018) also investigated self-concept as a motivating factor in choosing a major and found that self-concept clusters are indeed associated with college major selection for math and English.

In one of the few existing studies with a strong ESC focus, Quimby et al. (2007) examined the role of social cognitive variables in how interested students might be in environmental careers and environmental problems. Perceived outcomes/rewards and attitudes toward environmental problems are apparently predictors of interest in ESC. Ignatow (2006) argues that social conditions determine an individual's concern for the environment and that education does indeed impact environmental attitudes at the individual level, suggesting that social conditions and exposure to ESC courses could combine to significantly influence an undergraduate's selection of environmental science. Berenguer (2007) found that individuals who are capable of empathizing with the natural world are more likely to be interested in nature and are more likely to want to conserve and protect nature. Berenguer's research suggests that such empathy could be a factor in whether or not an individual decides to select ESC as a major and that the ability to produce empathy in students could be a powerful recruitment tool for environmental educators. Finally, Rask and Bailey (2002) suggest that environmental educators can serve as role models to students and that the more classes students take with an instructor who they can identify with, the more likely those students will select that course of study as a major.

Materials and Methods

This project took advantage of a mixed-methods design (Flick, 2009). First, broad qualitative interview questions, approved by UTC's Institutional Review Board (IRB # 10-168), were constructed to mine information from fifteen purposively selected ESC majors at the University of Tennessee at Chattanooga. While random sampling would in some ways have been advantageous, purposive sampling, a sometimes useful and legitimate sampling approach in qualitative research (Flick, 2009), proved useful in this scenario given budget and time constraints and in light of the exploratory nature of the study. These interview questions revolved around participants' opinions of environmental science as a course of study, the participants' personal values, the reasons behind their selection of environmental science as a major, and which of those reasons they deemed the most important. More specifically, the following questions were utilized: how do you view environmental science as a discipline and as a course of study; describe your own personal values and comment on whether or not the way you see yourself influenced your selection of environmental science; when you made your decision to select environmental science, what factors or concerns influenced your decision and which were the most important to you, etc. The fifteen individuals were interviewed one at a time (30 minutes per interview) on campus at the University of Tennessee at Chattanooga using the exact same series of questions. If responses revealed something unusual or unexpected, the interviewer asked additional questions exploring those areas. The researchers took advantage of three different phases of coding: open, axial, and selective. During open coding, highlighting and note taking were used in the margins of the interview-protocol sheets and a series of categories developed. The categories were then refined and differentiated through axial coding. Using selective coding, the categories were grouped. The central overarching phenomena that drive the selection of ESC as a major were then identified (Flick, 2009).

Access to a larger sample for the purposes of the distribution of a quantitative survey measuring student attitudes towards various factors that influence the selection of a major was gained through introductory ESC laboratory courses and through some of the 3000 and 4000 level ESC classes at UTC. This allowed for the surveying of freshmen, sophomores, juniors, and seniors of all races and genders, majors and non-majors alike. To ensure a high rate of participation and return, the survey was administered and taken up during the same class period.

In addition to requesting basic demographic data, the survey also asked students to rank the following *major selection factors* in terms of importance on a 1 to 6 scale, with 1 being the least important in terms of selecting a major and 6 being the most important: future earning potential, future job outlook,

prestige, ease of major, level of personal interest, and sense of personal satisfaction. The surveys were numbered and the data entered into SPSS (Hinkle et al., 2003). The rankings were analyzed with separate independent t-tests to evaluate the hypotheses that there is no difference among majors and non-majors in terms of perceived importance for the various major selection factors (Hinkle et al., 2003).

Results and Discussion (Qualitative)

Students reported a variety of properties across multiple points-of-view, properties that were then organized into several categories (Creswell, 2007). These categories were then grouped into one of two overarching central phenomena: (1) Early Experiences and (2) Affective and Practical Drivers, e.g., (Table 1).

TABLE 1. Central Phenomena driving ESC selection.

Early experiences	Affective/practical drivers
Influence of family	Passion
Influence of faith	Positive feelings about major
Introductory ESC courses	Sense of fulfillment
Interactions with professors	Potential for employment
Early field/lab experiences	

Early Experiences

According to the initial interviews, Early Experiences influence the selection of ESC as a major. These early experiences may be early life experiences or early influences on the values and beliefs of a person. The participants mentioned the influence of family in shaping their attitudes towards the natural world and ultimately towards their future major. For example, one student spoke quite lovingly of his father and another of his grandfather as individuals that had helped shape their personal values and love of nature. Both asserted that these relationships and the personal values imparted to them by these beloved family members had helped influence their selection of environmental science.

It was not just the influence of family that helped shape the attitudes and personal values of the participants and ultimately their selection of ESC. There was evidence of faith and spirituality at work as well. Several interviewees expressed the importance of being good stewards, because they felt from a young age that this is what God had called humans to do, to take care of Creation. The emphasis that these individuals placed on being good stewards was closely related to their own deeply ingrained values and had helped along their selection of ESC as a major.

For most of the participants, the interviews revealed again and again a sense of closeness with nature, a sense of closeness imparted by family and faith, a sense of closeness that demanded that being mindful of the natural word carried with it an almost moral responsibility to be mindful of the rest of humanity. It should be noted that Early Experiences also includes events that occur very early on in the college career. Several students spoke of the importance of the introductory ESC experience and how the introductory ESC courses had played a significant role in influencing and reinforcing their decision to select ESC. Some commented that they were attracted to the major because they loved the interdisciplinary nature of ESC. Environmental science is indeed interdisciplinary (Raven et al, 2015), with this concept introduced for the first time in the introductory courses.

Interestingly, it was not always the material itself that helped along the decision to select ESC as a major. Sometimes, it was just the interest and effort demonstrated by the introductory ESC professors. One student commented that she was extremely impressed when her introductory ESC professor made an effort to learn the names of the students in his class. Another commented on how helpful his ESC professor had been during an advisement period, and still another was greatly impacted by the openness and receptivity of the introductory ESC faculty. Participants reported that a positive view of introductory ESC professors influenced their decision to select environmental science as a major.

Within that introductory experience, fieldwork and laboratory experiences appear to be important as well. For some, introductory fieldwork and laboratory work helped to confirm the decision to select environmental science. This was a recurring theme during the interviews. Either the introductory classes and the introductory labs themselves or the introductory instructors or sometimes both provided for the student confirmation of the decision to select ESC as a major.

Affecting and Practical Drivers

In addition to Early Experiences, another central phenomenon is Affective and Practical Drivers. As for the affective, the word passion and the concept of the importance of passion appeared numerous times during the interviews. Students talked about the importance of feeling passion for the major, with some suggesting that the passion of professors in the introductory classes (a return to Early Experiences) can trigger passion in the students, which in turn helps inspire students to select environmental science. Students also reported wanting to feel good about themselves and about their major. They reported wanting to ultimately feel good about their choice of a career, and a strong desire to eventually feel like they were making a difference in the world. According to the participants, this mode of thinking had influenced their selection of ESC.

While students referenced affective concerns, and indicated that a sense of fulfillment with their major and within their jobs was of the utmost importance, it should be noted that affective concerns alone are not the sole driving force behind the selection of ESC. Students are also mindful of practical drivers, especially the potential for employment. Although no one mentioned a desire to make large sums of money, almost everyone mentioned that they believed job prospects in the field would be excellent well into the future. Overall, it seemed as though the potential for finding a job was one of the most important factors in selecting environmental science as a major (given the way this factor kept reoccurring during the interviews), much more so than the potential for finding a high-paying job.

A Preliminary Supposition

What influence do personal values have on the selection of ESC? What role, if any, does experience with ESC classes and/or

TABLE 2. Importance of selection factors for ESC majors and non-majors (average ranks).

	ESC-majors	Non-majors	*P* value	df
Earning potential	**3.25**	**3.60**	**0.291**	**62**
Job outlook	4.25	3.59	0.052*	
Prestige of major	2.43	2.50	0.860	
Ease of major	2.40	2.20	0.661	
Personal interest	4.60	4.70	0.651	
Personal satisfaction	4.10	4.39	0.483	

TABLE 3. Ranking of major selection factors for ESC majors and non-majors.

	ESC-majors	Non-majors
1	Personal interest	Personal interest
2	Job outlook	Personal satisfaction
3	Personal satisfaction	Earning potential
4	Earning potential	Job outlook
5	Prestige of major	Prestige of major
6	Ease of major	Ease of major

ESC professors have on the decision to select environmental science? What other factors influence the decision to select ESC? What about a preliminary supposition to help explain why students select environmental science as a major?

Early experiences are closely tied to personal values. For a future environmental science major, early life experiences are crucial, and are shaped by both family and faith. These early life experiences help to impart a love of nature, which, when expressed, makes it more likely that certain individuals will look favorably upon nature and upon environmental science as a discipline. If individuals look favorably upon environmental science, they are more likely to select ESC as a course of study. Just as early life experiences are important and influential, early experiences that occur within the college and university setting are important and influential as well. In particular, positive experiences in the introductory environmental science classroom are key, as are opportunities to interact with passionate environmental science instructors. Students that select ESC may already be predisposed to do so because of their personal values; even so, these students can be encouraged and their choice to select ESC reinforced and affirmed though other factors, both affective and practical. In particular, ESC majors should be made to understand that an environmental science degree is practical in that it affords a graduate a multitude of options and potentially a variety of employment opportunities.

Results and Discussion (Quantitative)

Seventy-two surveys were returned (nine were not able to be analyzed because they were filled out incorrectly). Of the 72 respondents, 28 reported being ESC majors (38.9%) and 44 reported being non-majors (61.1%). In terms of gender, of the 72 respondents, 31 (43.1%) were male while 41 (56.9%) were female. In a similar manner, among the 28 who reported being ESC majors, 13 (46.4%) were male with the other 15 (53.6%) female. Overall, females were slightly more represented. The respondents were not asked to identify their ethnicity.

Independent sample t-tests were conducted in SPSS to evaluate the hypothesis that there is no difference between majors and non-majors in terms of perceived importance for a variety of major selection factors, namely, future earning potential, future job outlook, prestige, ease of major, level of personal interest, and sense of personal satisfaction. These major selection factors were informed in large part by the results of the initial interviews and/or derived from the literature. With regard to student ranking of the various factors that influence the selection of a major on a 1 to 6 scale, with 1 being the least important and 6 being the most important, with the ranks being treated as scores, the null and alternate hypotheses are as follows:

Ho: μ majors = μ non-majors, for future earning potential, future job outlook, etc.

Ha: μ majors $\neq$ μ non-majors, for future earning potential, future job outlook, etc.

The test for future job outlook is significant at the 0.1 level, $t(62) = 1.981$ and $P = 0.052$, e.g., (Table 2). Future job outlook in selecting a major is therefore statistically greater for ESC majors (with an average rank score of 4.25) than it is for non-ESC majors (3.59). It should additionally be noted that given the low averages for both prestige and ease, neither factor appears to be important for either group. Clearly, level of personal interest is important for majors and non-majors, given the high averages. Overall, personal interest is the most important factor for both groups, with level of personal satisfaction the second most important.

How do ESC majors differ from non-ESC majors in terms of the importance of the various major selection factors, and which factors are most important to an ESC major? Overall, both majors and non-majors feel remarkably similar about the various factors that influence the selection of a major. Although both groups are most influenced by level of personal interest and level of personal satisfaction, the environmental science majors are influenced to a greater degree by future job outlook, e.g., (Table 3). This suggests that environmental science majors select ESC in part because they believe that there will be many job prospects within the field in the years to come.

The quantitative findings nicely echo the similar notion uncovered during the qualitative interviews. Again and again, during those interviews, majors stressed that one of the most appealing features of environmental science was the potential for finding a job. This may in fact be the most important piece of information uncovered by the study, especially for instructors seeking to recruit new environmental science majors. Certainly, this piece of information has significance for struggling environmental science departments in terms of how to best market their programs and recruit new majors. Programs and departments should emphasize the careers available to graduates with environmental science degrees.

Conclusions

Although we as educators and as environmental science recruiters have no control over or impact upon the early life

experiences of our students, we have maximum control over their introductory environmental science experience. We have this control in the way we conduct our classes and also to some extent in the way we conduct ourselves. Educators should strive to provide a wide array of experiences and to always stress the interdisciplinary nature of environmental science, all the while promoting and reinforcing the affective concerns that have perhaps already been rooted within the students by both family and faith. In addition to inspiring feeling and empathy for the natural world, and a moral obligation to protect our planet and respect others, it is equally important for introductory environmental science professors to make sure that students are adequately trained. Adequate training ensures that ESC students will be competent so that they might be better equipped to acquire a solid and satisfying, if not high- paying, job. Such efforts on the part of environmental science educators will make it more likely that students who already are predisposed toward the natural world will select environmental science as a major. Such efforts serve as a source of confirmation and encouragement by validating the educational choice of the environmental science major and making successful completion of an environmental science degree more likely.

Perhaps most crucial, given that it is so important to ESC majors, job outlook for environmental science professionals should be stressed and promoted. This can be done in a simple manner, with the introductory ESC professors emphasizing in class and at every opportunity the projected growth reported by the Bureau of Labor Statistics (2018). Or, it can be accomplished with a more concerted, organized effort: through marketing materials (brochures and posters), by bringing in guest speakers and job recruiters, and/or through coordinated job fairs and career days.

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