journal
of
interpretation
RESEARCH

volume 9
number 1
2004

interpPress

THE NATIONAL ASSOCIATION FOR INTERPRETATION

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Subscription:
$35 domestic, $45 international

ISSN 1092-5872

The Effects of Environment-Based Education on Students' Achievement Motivation

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Abstract
This mixed-methodology study examined the relationship between environment-based education and high school students' achievement motivation. Four hundred 9th- and 12th-grade students from 11 Florida high schools participated in the study. A Pretest-Posttest Nonequivalent Comparison Group Design (9th grade) and a Posttest Only Nonequivalent Comparison Group Design (12th grade) were used in the study. Interviews of students and teachers were used to support and explain the quantitative data. Data collection took place over the 2001–2002 school year. When controlling for pretest score, GPA, gender, and ethnicity, environment-based programs had a positive effect on 9th grade students' achievement motivation. When controlling for GPA, gender, and ethnicity, environment-based programs had a positive effect on 12th-grade students' achievement motivation. The results of this study support the use of environment-based education for improving achievement motivation and can be used to guide future program implementation. Implications for formal educators, environmental educators, and interpreters are discussed.

Keywords
environment-based education, environmental education, education reform, high school, motivation, achievement motivation

Introduction

In 1983, the National Commission on Excellence in Education labeled the United States "A Nation at Risk." Twenty years later, there is still much progress to be made. Since 1983, over 10 million Americans reached the 12th

grade without learning to read, and over 6 million Americans dropped out of high school altogether (National Research Council, 1999). According to *The Nation's Report Card: Mathematics 2000,* only 17% of 12th-grade students performed at or above a level of proficiency (U.S. Department of Education, 2001). In science, 82% of 12th-grade students performed below the proficiency level on the 2000 National Assessment of Educational Progress science test, unable to demonstrate competency in subject matter and apply knowledge and skills to real world situations (U.S. Department of Education, 2002b).

Years of Promise, a 1996 report by the Carnegie Task Force on Learning in the Primary Grades, describes these inadequacies in American schools from a different perspective: "Something happens to many American children . . . something elusive and disturbing. Over the years, they lose their natural curiosity and their enthusiasm for learning" (in National Research Council, 1999, p. 36). Educational statistics back this claim, as only 21% of 12th-grade students' said their schoolwork was "quite or very interesting," and only 28% reported that their schoolwork was "often meaningful" (U.S. Department of Education, 2002a).

Given its research-based links to cognitive engagement and academic performance, it is not surprising that declining student achievement accompanies this national trend in declining motivation. Students with positive motivational beliefs will be more likely to become engaged in learning in a deeper, more self-regulating fashion than those who do not have these beliefs (Pintrich & Schrauben, 1992). While having positive motivational beliefs may not lead directly to improved academic performance, these beliefs can lead to increased cognitive engagement in the task, which does have a direct influence on academic performance (Pintrich & Schrauben, 1992). Because of this link to cognitive engagement and academic performance, motivation plays a key role in education reform, and increasing student motivation has been identified as holding great potential for improving student achievement (National Research Council, 1999).

Environment-based education is emerging as an effective means for motivating students and making learning relevant through real-world projects and problem-solving opportunities. Environment-based education is a general term for describing formal instructional programs that adopt local natural and socio-cultural environments as the context for a significant share of students' educational experiences. Its defining characteristics are as follows:

- *Interdisciplinary learning based on the local natural or socio-cultural environment.* As course content is connected to the local environment, the traditional lines between basic subject areas are blurred.
- *Project- and issue-based learning experiences.* Learners are actively engaged in the learning process, posing and solving problems, investigating issues, and producing products. There is an audience beyond the teacher for learners' work, assuring students' their work is needed and worth doing.
- *Learner-centered instruction.* The central focus of the learning experiences grows out of students' interests and questions, and students have a voice in deciding what is needed and how to carry out their work.
- *Constructivist approaches.* New learning activities stem from previous activities, building on skills and understandings learned from past experiences. Reflection is an essen-

tial activity that takes place at throughout the learning process, helping students absorb and process what they have experienced (definition and characteristics adapted from NEETF, 2000; SEER; 1998).

By focusing on the local environment, environment-based education addresses a major educational concern: "the lack of connection between formal schooling and students' lives, a disconnect that makes learning an imposed chore rather than an opportunity to explore questions that arise from students' innate curiosity and desire to become competent and contributing members of their families and communities" (Smith, 2002, p. 30). By relating learning to the lives and concerns of students, environment-based education "takes advantage of students' natural interest in the world and their desire to be valued by others" (Smith, 2002, p. 30).

According to the 1998 study by Gerald Lieberman and Linda Hoody, *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*, benefits of environment-based programs can include improved performance on standardized tests, reduced classroom management problems, and increased engagement and enthusiasm for learning (Lieberman & Hoody, 1998). The National Environmental Education & Training Foundation (NEETF) report, *Environment-based Education: Creating High Performance Schools and Students*, consists of case studies of schools successfully using the environment to provide meaningful learning experiences. In addition to improved scores on assessment tests and a decline in discipline problems, these environment-based programs are creating conditions conducive to learning, resulting in increased student motivation and higher-level thinking skills (NEETF, 2000).

These results are encouraging, particularly given the need to improve the quality of public education, and have implications for environmental educators and interpreters, as well as formal educators. However, there is limited research documenting a connection between environment-based education and student motivation, and to date, most of the evidence has been qualitative or anecdotal. More research is needed, as research is critical in determining which strategies and programs are worth exploring and which are ready for widespread implementation (Atkinson & Jackson, 1992). Further, research is essential for developing new ideas to their full potential and for "building capacity in the education system for continuous learning and renewal" (Atkinson & Jackson, 1992, p. 13).

Methods

The purpose of this research was to examine the relationship between environment-based education and students' achievement motivation. The following questions were addressed in this research:

1. What is the relationship between environment-based education and high school students' achievement motivation?
    a. When controlling for pretest scores, achievement level, gender, and ethnicity, do 9th-grade students who participated in environment-based education programs have higher levels of achievement motivation than their peers in traditional instructional programs?
    b. When controlling for achievement level, gender, and ethnicity, do 12th-grade stu-

dents who participated in environment-based education programs have higher levels of achievement motivation than their peers in traditional instructional programs, including traditional environmental science?

2. How does variation in the implementation of environment-based education programs influence its effects on students' achievement motivation?

Participating Programs and Students

Environment-based programs in 12 Florida high schools were selected for participation through operational construct sampling (finding manifestations of the theoretical construct of interest) and maximum variation sampling (purposefully picking a wide range of cases for external validity), as described by Patton (1990). These programs met the defining characteristics of environment-based education (described previously), were in operation for at least two years, and were willing to participate in the study. In addition, these programs represented a range of student socio-economic statuses and average achievement levels, as well as a range of geographic locations (urban, suburban, and rural schools throughout Florida), which contributed to the external validity of the study.

Four hundred 9th- and 12th-grade students from 11 of the 12 selected programs participated in this study. These students agreed to participate and had parental permission through the consent process mandated by the University of Florida's Institutional Review Board. Participants were 42.9% male and 57.1% female; 56.5% were white, 33.2% were non-white students, and 10.3% did not indicate their ethnicity.

Treatment

The treatment examined in this study was an established educational intervention—environment-based education. Environment-based education programs are formal instructional programs that adopt local natural and socio-cultural environments as the context for a significant share of students' educational experiences. A thorough description of environment-based education can be found in NEETF (2000) or SEER (1998). While environmental literacy is often an outcome of environment-based education, fostering student learning in all subject areas is its primary goal. Consequently, it is distinguished from environmental education, which has the primary goal of environmental literacy. Environment-based education is also in contrast to traditional instruction, including traditional environmental science instruction, which lacks problem- or project-based instructional strategies, is teacher- rather than student-centered, and does not use an environmental context for integrating multiple subject areas

Design

To control for differences due to grade level, the 9th- and 12th-grade students were studied separately. A Pretest-Posttest Nonequivalent Comparison Group Design, as described by Cook and Campbell (1979), was used for the 9th-grade study. This involved a pretest and posttest for students in the treatment group (n = 89) and students in a non-randomized control group (n = 83). Students in the control group received traditional instruction at the same school or a school comparable in geographic setting and average student achievement and socio-economic level. The validity threat of selection differences was addressed through statistical controlling for pre-existing differences in initial motivation level,

Figure 1. The Achievement Motivation Inventor.

Student Number _____

Date _____

Circle: Freshman Sophomore Junior Senior

Circle: Male Female

Is English your primary language? Yes No

Please respond as honestly as possible. There are no right or wrong answers!	Strongly Agree	Agree	Not Certain	Disagree	Strongly Disagree
1. I'm doing a good job of learning in school.	SA	A	NC	D	SD
2. I often feel like I have little control over what happens to me in school.	SA	A	NC	D	SD
3. It doesn't matter whether or not I learned from an assignment, as long as I get a good grade on it.	SA	A	NC	D	SD
4. In my opinion, what is taught in my classes is not worth learning.	SA	A	NC	D	SD
5. I often worry that I am not very good at school.	SA	A	NC	D	SD
6. I sometimes get to make choices about what and how I learn.	SA	A	NC	D	SD
7. The only reason I try to do well at school is to please my teachers or parents.	SA	A	NC	D	SD
8. Most of what I'm learning at school is important to me.	SA	A	NC	D	SD
9. At times I feel that I'm not good at anything at school.	SA	A	NC	D	SD
10. When I try hard, I do well on my schoolwork.	SA	A	NC	D	SD
11. I try to learn as much from my schoolwork as I can.	SA	A	NC	D	SD
12. School is usually boring.	SA	A	NC	D	SD
13. I feel I always need help with difficult schoolwork.	SA	A	NC	D	SD
14. It doesn't matter how much effort I put into my schoolwork, because I get the same grades whether I try hard or not.	SA	A	NC	D	SD
15. I do not want to learn a lot of different things in school. I just want to learn what I need to get a good job.	SA	A	NC	D	SD
16. I'm usually interested in what I'm learning at school.	SA	A	NC	D	SD
17. I feel good about my ability to do schoolwork.	SA	A	NC	D	SD
18. At school, I have many questions I don't get to ask.	SA	A	NC	D	SD
19. I do my schoolwork so my teachers or parents don't get mad at me.	SA	A	NC	D	SD
20. Going to school is a waste of time.	SA	A	NC	D	SD

Note: This instrument has been revised based on item analysis and factor analysis data from its use in this study. Items 7 and 11 have been revised, which should increase the reliability and validity of scores. Item 7 was originally stated as "I try to do well at school to please my teachers or parents." Item 11 was originally stated as "I set high standards or goals for myself."

Table 1. Table of Specifications for the Achievement Motivation Inventory.

Domain	*Number of Items*	*Item Numbers*
Self-Efficacy	5	1, 5, 9, 13, 17
Control	5	2, 6, 10, 14, 18
Goal Orientation	5	3, 7, 11, 15, 19
Task Value	5	4, 8, 12, 16, 20

achievement level (GPA), gender, and ethnicity by adding these variables to the statistical models as covariates.

Because many of the 12th-grade students had participated in environment-based programs in previous years, a pretest was not possible. Thus, a Posttest Only Design with Nonequivalent Groups, as described by Cook and Campbell (1979) was used for the 12th-grade study. This involved a posttest for students in the treatment group (n = 126) and students in a non-randomized control group (n = 102). Students in the control group received traditional instruction at the same school or a comparable school. The validity threat of selection differences was addressed through statistical controlling for pre-existing differences in achievement level, gender, and ethnicity by adding these variables to the statistical models as covariates.

Research Instrument

The Achievement Motivation Inventory (AMI) measures overall motivation toward academic achievement through a 20-item inventory that takes approximately 15 minutes to complete (see Figure 1). Each item has five response categories: "strongly agree," "agree," "not certain," "disagree," and "strongly disagree." Items on the instrument are scored as follows: Each item is worth a maximum of five points, with a possible total score of 100. For the items stated as positive to achievement motivation, the response "strongly agree" is worth five points, and the responses "agree," "not certain," "disagree," and "strongly disagree" are worth four, three, two, and one point, respectively. For the items stated as negative to achievement motivation, the response, "strongly agree," is worth one point, and the response "strongly disagree" is worth five points. Higher total scores indicate higher levels of achievement motivation.

This inventory was developed specifically for this study as a non-content-specific, holistic measure of achievement motivation in the context of education reform. It was based on a general social cognitive model (Pintrich & Schrauben, 1992) commonly accepted in motivation research. Four of the items (2, 4, 11, and 15) were adapted, with permission, from the *Learning and Study Strategies Inventory–High School Version* (Weinstein and Palmer, 1990).

After a motivation researcher at Michigan State University conducted a content analysis of the instrument and determined it addressed the four components of the general social cognitive model (self-efficacy, control, task orientation, task value), it was piloted in a Florida school before its use in this study (see Table 1 for a table of specifications). The reliability coefficient (internal consistency) of the pilot data (n = 81) was .84, as measured using Cronbach's alpha. A factor analysis of the pilot data revealed that a one-factor model accounted for 25% of the variance; 19 of the 20 items loaded onto this factor. Based on

teachers' suggestions, three revisions were made: The "Times New Roman" font was changed to "Comic Sans MS," as teachers suggested students would be more responsive to a "friendlier" font. Teachers also suggested adding the instructions for students to respond as honestly as possible, as there are no right or wrong answers. Finally, teachers suggested using "Student Number" rather than "Name" as the prompt for students' identification information, to further emphasize the anonymous nature of this inventory.

The reliability coefficient (internal consistency) of the posttest data collected from 9th-grade students in this study (n = 172) was .79 and .76 (n = 228) for the 12th-grade data, as measured using Cronbach's alpha. For the purpose of construct validation, the dimensionality of the 20-item scale was analyzed using a factor analysis with a maximum likelihood extraction method. The rotated solution for the 9th-grade posttest data yielded one interpretable factor, which accounted for 21% of the item variance; 18 of the 20 items loaded onto this factor. The rotated solution for the 12th-grade posttest data yielded one interpretable factor, which accounted for 23% of the item variance; 18 of the 20 items loaded onto this factor.

Procedures

All data collection took place over the 2001–2002 school year. The researcher visited each school to explain the data collection procedures and instrument administration guidelines. Teachers administered the instruments to the 9th-grade students as pretests within the first month of the school year and as posttests within the last month of the school year. Teachers administered the instruments to the 12th-grade students as posttests within the last two months of the school year. In addition, information on students' gender, ethnicity, and achievement level was collected.

Qualitative Methods

The purpose of the qualitative investigation was to ensure that the participating programs met the defining characteristics of environment-based programs. This qualitative investigation also was used to determine what students and teachers identify as factors influencing motivation. These insights were used, in conjunction with the quantitative findings, to develop recommendations for future program implementation.

Each program was visited at least once for four to seven hours. Interviews were conducted with one teacher from 10 of the participating programs, lasting 30-90 minutes each, according to techniques described by Lindolf (1995). The following questions were used to initiate the discussion, with the interviewees expounding on what they believed was important for the researcher to know:

1. What do you consider to be the most successful features of your program?
2. Do you think participation in this program motivates students to put their best effort into learning? If the response is yes: What characteristics of your program would you identify as having the greatest impact on students' motivation?

Teachers were asked to select three to six students for in-depth interviews. Interviews were conducted with 44 students representing 10 of the 11 programs, each lasting 10–30 minutes. The following questions were used to initiate discussion with the students:

1. What do you do in this program?

2. What parts of the program do you like best?

3. Has this program changed the way you feel about school or the way you feel about learning? If the response is yes: What about this program has changed the way you feel about school? What about this program motivates you?

During the interviews with teachers and students, data were collected by the researcher through audio tape recorders and field notes. Each tape was transcribed after the interviews at one program were completed and before the interviews at the next program were conducted.

Limitations

The schools involved in this study varied in terms of school culture, administrative support and leadership, faculty experience level and turnover rate, and student populations. Further, environment-based education is a broad term, allowing schools flexibility in its implementation. Due to this naturalistic setting that is common in educational research, the research questions involved in this study could not be investigated feasibly through an experimental design. Thus, the internal validity of the study was weakened. External validity, however, was strengthened through the inclusion of a diversity of programs and settings.

Due to issues of administration time, a single measure of achievement motivation was used. While this minimized the intrusiveness of assessment on class time and student learning, the use of a single measure may have resulted in threats to construct validity from mono-operation (single measure) and mono-method (single method) biases. The quantitative data collected from this measure was supplemented with qualitative data from observations and interviews to decrease these construct validity threats.

Quantitative Data Analysis and Results

Multiple linear regression was used to determine if students in environment-based programs had higher scores on the AMI than students in traditional instructional programs, after controlling for the variance in scores due to students' initial motivation level, achievement level, gender, and ethnicity (Research Question 1). To examine the influence of treatment variations on students' achievement motivation (Research Question 2), a factorial analysis of covariance (ANCOVA) was used. School was used as a proxy variable in this analysis to represent the specific way in which the treatment was implemented at each school, thus incorporating variation in program implementation into the statistical model. The Type I error for the analysis was set at $\alpha = .05$. Because each analysis involved two inferential research questions (the effects of the treatment on 9th-grade students and the effects on 12th-grade students), the Bonferroni method was used to control for a spiraling Type I error rate. Thus, the explanatory variable, covariates, and interaction terms were tested using a Type I error rate of $\alpha = .05/2 = .025$. Missing data was handled through excluding cases listwise.

For the 9th-grade study, the treatment was statistically significant ($b = 2.752$, $t(166) = 2.259$, $p = .025$; see Table 2). These results suggest that when controlling for pretest score, GPA, gender, and ethnicity, there was a significant positive effect of the environment-based programs on students' achievement motivation; 9th-grade students in the environment-based programs scored 2.75 points higher on the 100-point inventory than 9th-grade students in the control group. This effect was not a function of initial skill level (pretest),

Table 2. Summary of Regression Analysis for Variables Predicting Students' Achievement Motivation.

Variable	Unstandardized Regression Coefficient	Standard Error	Standardized Regression Coefficient	Observed *t* value	*p* value	Partial Correlation	Semi-Partial Correlation
			9th Grade[a]				
Pretest	.629	.059	.616	10.682	.000*	.637	.594
GPA	2.066	.877	.136	2.357	.020*	.179	.131
Gender	.280	1.222	.013	.229	.819	.018	.013
Ethnicity	1.255	1.264	.056	.993	.322	.077	.055
Treatment	2.752	1.218	.129	2.259	.025*	.172	.126
			12th Grade[b]				
GPA	2.641	1.479	.125	1.786	.075	.119	.110
Gender	.784	1.366	.037	.573	.567	.038	.035
Ethnicity	6.788	2.080	.311	3.263	.001*	.213	.201
Treatment	8.557	1.876	.402	4.562	.000*	.292	.281
Treatment by Ethnicity	7.777	2.792	.275	2.785	.006*	.183	.172

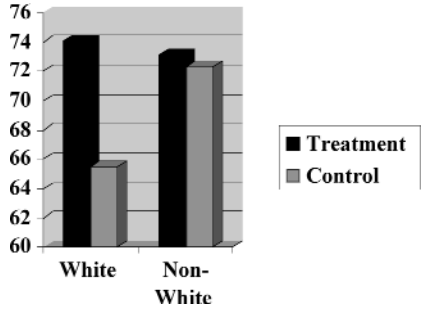
Note.
[a]$n = 172$. [b]$n = 228$.
[a]$R^2 = .484$. [b]$R^2 = .152$.
*$p \leq .025$.

achievement level (GPA), gender, or ethnicity. While these variables did not moderate the effect of the environment-based programs, initial motivation level (pretest) and achievement level (GPA) significantly *influenced* students' achievement motivation. Thus, students with higher pretest scores and students with higher GPAs had *systematically* higher posttest scores than those with lower pretest scores and GPAs, but the environment-based programs were not more *effective* (working differently) for the students with higher pretest scores and GPAs.

For the 12th-grade study, the treatment was statistically significant ($b = 8.557$, $t(222) = 4.562$, $p < .001$; see Table 2). However, the interaction term, treatment by ethnicity, was statistically significant ($b = 7.777$, $t(222) = 2.785$, $p = .006$). These results suggest that when controlling for GPA, gender, and ethnicity, there was a significant positive effect of the environment-based programs on 12th-grade students' achievement motivation; this effect, however, was moderated by ethnicity. White students in the environment-based programs scored 8.56 points higher on the 100-point inventory than white students in the control group. Students' scores were not significantly influenced by GPA or gender. The treatment effect was not significant for non-white students, as there were no significant differences between the non-white students in the environment-based programs and the non-white students in the control group. This, however, may be a function of the data, as the scores of the non-white students in the control group were significantly higher than the scores of the white students in the control group (see Figure 2).

In the analyses addressing variation in program implementation, the treatment by school interaction terms were not statistically significant in the 9th-grade study ($F(1, 164) = .093$, $p = .761$) or in the 12th-grade study ($F(4, 213) = 1.389$, $p < .239$). This suggests that variation in implementation of environment-based programs across the participating

Figure 2. Estimated Marginal Means of 12th-Grade Students' Achievement Motivation Posttest Scores.



schools did not moderate the effects of the treatment on 9th- and 12th-grade students' achievement motivation; the effectiveness of the treatment was not a function of program implementation. In other words, some programs were not more effective than others in motivating students. Further, this suggests that the effectiveness of environment-based education may apply to schools beyond this study, as the results were not dependent on the way in which the programs were implemented.

Qualitative Data Analysis Results

Data analysis of the 10 teacher interviews and 44 student interviews consisted of analyzing the transcripts according to a general process of data reduction and interpretation described by Gay and Airasian (1996). This process involves becoming familiar with the data through careful reading, organizing the data by coding pieces of data and classifying them into themes or categories, and synthesizing the organized data into general conclusions or understandings. The focus of this process is analytic induction.

Inductive analysis, described by Guba (1978) in Patton (1990), was applied to find themes, or recurring regularities or patterns, which emerged from the data. The criteria for the creation of a theme, suggested by Krueger (1998), was the frequency and extensiveness of responses, as well as the intensity and specificity of responses.

The following are the themes generated from the inductive analysis described above, followed by verbatim quotations to illustrate each theme and an explanation. To avoid conveying the impression that the results can be projected to a population and because frequency and extensiveness of responses were not the only criteria used, numbers and percentages have not been reported. Environment-based programs appeared to influence students' achievement motivation when they:

- Used the local environment as a motivating context.

  "The environmental theme is effective in motivating kids, especially inner-city kids. For many of them, it's their first time interacting with nature, and it's a totally different setting than they are used to. Instead of being on edge, they can let their guards down and have some peace and quiet. It helps rebuild their spirits. And once they feel safe and that someone cares about them, they can care about their education." (White, Male Teacher)

  "The environment approach works because the kids are interested in it. It's

> appealing to them, almost an innate interest, particularly in our rural setting. A lot of these kids grew up hunting and fishing. They like being in the environment and that interest makes learning more appealing." (White, Male Teacher)

Teachers and students at the rural and urban schools placed a stronger emphasis on the ability of the local environment, specifically the natural environment, to serve as a motivating context than teachers and students at suburban schools. Students at these rural and urban schools intensely echoed their teachers' emphasis of the natural environment's ability to serve as a motivating context. Other students and teachers described a different source of motivation relating to the environment. Using the environment as a context for learning provided teachers with interdisciplinary opportunities to tailor learning experiences to the interests and strengths of the students.

> "One of my students, a track star, was really struggling with math. He had failed algebra and was back for a second year. This program gave him a purpose. He could tie the projects back to what he needed to learn for class—the number of square feet a gallon of paint could cover and how many gallons would be needed for the picnic tables at the state park. He didn't give up because he loved being outdoors, and we did our math out there." (White, Male Teacher)

> "Generally when you think of coming to school, you think of sitting in class and taking notes, getting homework, and going home. But here, you actually interact and get to do stuff you're interested in, and it makes it a lot more fun to learn. I think it helps us see what we are good at." (Black, Male, 12th-Grade Student)

- Involved the application of content and skills to real-life issues and problems through relevant, meaningful, hands-on learning that often generated a final product.

> "I like this program because it's hands-on. It's so hands-on I get blisters!" (White, Male, 9th-Grade Student)

> "We have had to speak at school board meetings and at the city council meetings. Our actions have real consequences. The community actually uses the research we do, and they're counting on us. They need our data, and it makes you think, 'Oh my gosh, I have to get it right the first time!' because they are going to be using that information." (White, Female, 12th Grade Student)

> "I have kids that aren't troublemakers, but they just haven't had opportunities that motivated them. But once they get to serve their community, they find their niche and become more confident and motivated to put their best effort forward." (White, Female, Teacher)

> "It's amazing that you can have kids that can't seem to get here with their shoes tied and properly dressed, but when they are told they are doing something that somebody in the community is going to use, then by gosh, they get it right!" (White, Male, Teacher)

Through relevant, hands-on learning, students had the opportunity to feel that they were valued members of the community. Their work had an audience beyond the teacher, who

affirmed their work was needed and worth doing. Often these projects resulted in a tangible final product, not just a grade, which also motivated students to put their best effort forward.

> "The final product is what motivates me—being able to see the final product of what you've worked on all year." (Asian, Female, 12th-Grade Student)

- Empowered students to be responsible for their own learning.

> "It's because it's student-driven. We make decisions, and we have responsibilities. I can learn at my own pace, and I can absorb more when I'm learning for a purpose." (White, Male, 12th-Grade Student)

> "You gain a lot of confidence because of the big projects we do. You gain a lot more confidence in yourself when you plan and carry out a project, rather than if someone just tells you exactly what needs to be done and how to do it. Now rather than looking at something and thinking that it's an impossible task or too big of a problem, now I know that I can do it." (Black, Female, 12th-Grade Student)

In the environment-based programs, the learning experiences were infused with learner choice, design, implementation, and revision. The investigative approaches of these programs allowed students to develop their own paths of learning and discovery, which were guided by their interests and concerns. Students and teachers consistently attributed increased motivation to opportunities to make choices about their learning and experience success and self-empowerment from processes and products that were their own.

These themes represent program characteristics that students and teachers believe influence achievement motivation. These characteristics, in essence, describe three of the defining characteristics of environment-based education programs: interdisciplinary learning based on the local environment, project-based learning experiences, and learner-centered instruction. Because improvements in achievement motivation were attributed to defining characteristics of environment-based education, this analysis can be interpreted as supporting the quantitative results: Environment-based education programs have a positive effect on students' achievement motivation.

Discussion

The results of this research suggest environment-based education programs have a positive effect on 9th- and 12th-grade students' achievement motivation. This effect at the 12th grade level, however, is moderated by ethnicity. Further, these results suggest the positive effect of environment-based programs on achievement motivation may also apply to schools not involved in this study, as variation in implementation is not moderating the results. Thus, a variety of environment-based program formats and settings seem to be effective in improving achievement motivation.

Although the effect sizes were small, the practical significance of these results should be noted. For example, 9th-grade students' in the environment-based programs scored only about three points higher than their peers in traditional programs on the AMI, but white 12th-grade students in environment-based programs scored almost nine points higher than their peers. Considering that the general trend is for motivation to decrease from 9th- to 12th-grade, these results are particularly encouraging: The trend of declining motivation was counteracted, with motivation levels of students in environment-based

programs increasing from 9th to 12th grade.

It is unclear as to whether the programs are effective in increasing non-white students' achievement motivation. This treatment by ethnicity interaction effect could be related to ethnicity differences in attitudes toward and interest in the environment. However, this would not explain why the non-white students in the control group had such a high level of achievement motivation, with scores on the AMI that were significantly higher than the scores of white students in the control group (see Figure 2). It is possible that environment-based programs were ineffective in increasing non-white students' achievement motivation due to a ceiling effect; the non-white students in the study appeared to already be highly motivated (see Figure 2). Perhaps this ceiling effect is related to trends in high school dropout rates, as the U.S. Department of Education's *Condition of Education 2002* reports that since the early 1990s, non-whites have had consistently higher dropout rates than whites (2002a). It may be that by the time non-white students reach their senior year of high school, they have higher achievement motivation levels than white students, as non-white students with lower motivation levels may have already dropped out of school.

The qualitative findings support the quantitative results, as teachers and students identified defining elements of environment-based programs as influencing students' achievement motivation. Collectively, these findings are consistent with the research literature regarding achievement motivation. For example, Lepper & Hodell (1989) recommend improving student motivation through instruction that is tied to topics and problems that naturally interest students. Teachers, according to their research, should facilitate connections between students' prior knowledge and experiences, illustrating the connection between the curriculum and the real world and emphasizing the relevance of instruction to students' personal lives. Further, research suggests that project-based learning, a defining characteristic of environment-based education, generates an enthusiasm for learning that cannot be generated when instruction is limited to textbooks (White, 2000). The findings of this study are also consistent with the qualitative findings of previous research on environment-based education: NEETF (2000) and SEER (1998) suggest the efficacy of using the environment to motivate students and engage them in learning.

The qualitative component of this study was useful beyond supporting the quantitative results. It extended the breadth of inquiry, providing insight into why environment-based programs have a positive effect on students' achievement motivation. Even though key stakeholders in environmental education and formal education communities often request quantitative data for program justification, the qualitative component of this study illustrates the usefulness of supplementing "numbers" with insights that can help explain the quantitative findings and guide future program implementation. Thus, in an evaluation context, integrating quantitative and qualitative approaches may be helpful.

Implications and Recommendations for Formal Educators

The results of this study suggest that environment-based education can be an effective way to engage high school students in learning by increasing achievement motivation. Teachers and administrators can use the results of this study to justify their environment-based programs, helping assure parents, superintendents, and state policy makers that these programs can produce desired and valued educational outcomes. The results of this study also provide recommendations for future implementation of environment-based programs.

One of these recommendations is to include students of all achievement levels in the

environment-based education programs. The results of the statistical analysis indicated that the effect of the environment-based programs on students' achievement motivation was not a function of achievement level (as measured by GPA). The treatment worked well for all achievement levels. Teachers' perceptions of the importance of including students of varying abilities in the environment-based programs further support these results. Teachers suggested that including students of varying abilities provides lower achieving students with role models and challenging standards and provides higher achieving students with the opportunity for peer teaching. Teachers also emphasized the effectiveness of environment-based education in highlighting the different strengths and skills of all students, resulting in positive changes in the social milieu.

A second recommendation is for continued recognition of the systemic nature of environment-based education in program implementation. Based on the qualitative results of this study, it appears that the environment serves as an effective motivating context for learning. Numerous teachers and students spoke about the power of the environment to engage students and to make learning relevant. The natural environment was particularly effective in motivating inner city students, as well as students in rural settings. However, this study also suggests the importance of the systemic nature of environment-based education—its incorporation throughout the entire educational system, from notions of teaching and learning to authentic assessment and community involvement, as students in environment-based programs had higher motivation levels than their peers in traditional instructional programs, including traditional environmental science classes. Thus, it may be that an environmental context, when confined to traditional teaching methods, does not improve motivation. However, when combined with project-based, learner-centered instruction, an environmental context can be motivating. Thus, the environmental context is not only a good integrator of subject areas, but also a good integrator of best practices in education.

Implications for Interpreters and Environmental Educators

What does student motivation have to do with interpretation and environmental education? Good teaching has much in common with good interpretation and environmental education. Interpreters and environmental educators know well the importance of concepts such as relevance, inspiration, and provocation. These concepts have been applied to formal educational activities through environment-based education, creating conditions conducive to inspiring a love of learning and engaging students in the learning process. Interpreters can model their skills in connecting visitors to the resources and provoking their interest in knowing more, helping teachers find additional ways to make lessons come alive.

Interpreters and environmental educators are often the source of connections between schools and the local natural or cultural resources and settings that become the foundation for students' formal learning experiences. Interpreters and environmental educators play a critical role in supporting environment-based education, as their expertise with the local resources can support research projects or issue investigations, and their skills in communication can effectively convey background content knowledge. They can further support environment-based education by providing students with opportunities to explore questions that arise from their natural curiosity in their surroundings and their desire to become contributing members of their communities. Their support is often essential to the success of environment-based programs, as the majority of the environment-based pro-

grams in this study depended on interpreters and environmental educators in partnering organizations and agencies to work with students on individual or group research projects, provide teachers with professional development opportunities, and connect programs with funding opportunities and other resources.

A further implication of this study relates to the educational trend toward accountability and evidence-based reform. Under the "No Child Left Behind" legislation, the federal government is investing in educational practices that have research-based evidence to support them. Educators will "increasingly be able to choose from among a variety of models known to be effective if well-implemented, rather than reinventing (or misinventing) the wheel in every school," and "schools making little progress toward state goals may be required to choose from among a set of proven programs" (Slavin, 2003, p. 16). Because this study did not compare environment-based programs against other innovative programs, these results do not suggest that environment-based education is more effective than other school reform programs. However, with evidence of effectiveness and an understanding of the conditions necessary for it to work, environment-based education can at least be considered by formal educators; it can be one of the models or proven programs educators can select and implement in the formal education setting.

The implications of this are significant, as it provides environmental educators with new avenues for funding. For example, through the Comprehensive School Reform Demonstration (CSRD) program, schools can receive a minimum of $150,000 over three years to implement a replicable, research-based comprehensive school reform program. While the CSRD program offers the potential for significant funding, a lack of knowledge within the environmental education community about the CSRD program and other federally-funded programs, as well as hesitation regarding their focus on improving academic learning, has prevented environmental education involvement in this program (NEETF, 2002). Consequently, the benefits of federal funding and consistent, high-quality access to the formal school setting have yet to be reaped by a wide audience. Therefore, leaders in environmental education should raise awareness of programs such as CSRD among environmental educators, encouraging them to take advantage of this opportunity to make new connections to school reform activities in their communities.

Recommendations for Future Research

- Explore the connection between the *natural* environment and student motivation: Are natural environments more effective in motivating students than socio-cultural environments, and does the effectiveness vary by school location and setting? Additional research might explore the environment used by suburban school programs to understand why it might be less motivating.
- Further investigate the relationship among achievement motivation, environment-based education, and ethnicity.
- Explore what characteristics make non-formal partnerships most productive and beneficial in motivating teachers and students to engage in environment-based education programs.
- Conduct additional analyses using Hierarchical Linear Modeling (HLM) to provide stronger evidence of the generalizability of these findings and to better

understand how variation in implementation of environment-based education affects the desired outcomes.

Conclusion

The disturbing disappearance of enthusiasm for learning stated by the Carnegie Task Force on Learning echoes a similar concern expressed by writer Rachel Carson over 40 years ago. "A child's world is fresh and new and beautiful, full of wonder and excitement," Carson declared in her 1956 book, *A Sense of Wonder*. Carson later wrote, "It is our misfortune that for most of us that clear-eyed vision, that true instinct for what is awe-inspiring is dimmed and even lost before we reach adulthood."

The results of this study provide evidence of environment-based education's ability to improve high school students' achievement motivation and support its use in school reform efforts. In addition to their educational relevance, environment-based programs appear to help students develop a positive outlook toward their ability to correct and prevent environmental problems, as noted in program observations and conversations with students. These programs are also targeting high school students—an audience that environmental educators typically do not reach and providing them with access to the environment. Further, the formal school setting provides the time needed for in-depth coverage of topics relating to the environment. When the goal of improving student learning is viewed as complementary with building environmental literacy, environmental educators and interpreters can help the wider education community understand that environment-based education is simply good education. This will go a long way in ensuring that, in the midst of education reform and its high-stakes standards and evaluation, environmental education does not get lost in the shuffle.

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Authors' Note

This manuscript was supported by the Florida Agricultural Experiment Station and approved for publication as Journal Series No. R-09751. The authors wish to acknowledge the following funders of this research: the Environmental Education Section of NAI, the EPA's National Network for Environmental Management Studies Fellowship Program, and the University of Florida and School of Forest Resources and Conservation's Alumni Fellowship Program.