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This study investigates the influence of Green School designation on students' achievement in state-mandated standardized tests. Data were gathered 3 years pre- and post-Green schools designation, from test pass rates in reading and mathematics for Grade 5 and Grade 8 students, and from mathematics, English language arts, and biology scores for secondary students. Analysis indicated that Green School designation was positively correlated with standardized test pass rates in many schools and across subjects. Future work should investigate the mitigating impact of variables such as student socioeconomic status and level of teacher certification on student achievement in Green Schools.

INTRODUCTION

Prior research indicates a positive relationship exists between students' involvement in environmentally based learning and academic achievement (Bartosh, 2003; Bartosh, Tudor, Ferguson, & Taylor, 2006, 2009, 2010; Short, 2010; Volk & Cheak, 2003), achievement motivation (Athman & Monroe, 2004) and self-efficacy and locus of control (Stern, Powell, & Ardoin, 2010; Zint, Kraemer, Northway, & Lim, 2002). However, a great deal of confidence and instructional decision making in environmental education (EE) rests on assumptions made by a few widely cited program evaluation reports or reviews (e.g., Lieberman & Hoody, 1998; Lieberman, Hoody, & Lieberman, 2000, 2005; Monroe, Randall, & Crisp, 2001; Wheeler, Thumlert, Glaser, Schoellhamer, & Bartosh, 2007) that rely on self-reports rather than data from controlled settings (Carleton-Hug & Hug, 2010; Stern, Powell, & Hill, 2013). Moreover, mandates included in No Child Left Behind (NCLB) have solidified the reality of large scale standardized testing in K–12 education in the United States; yet, tension exists between full realization of

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EE in formal K–12 education and instrumental goals of increasing student achievement in core academic areas (Gruenewald & Manteaw, 2007). To better understand the purported tension that exists between EE goals (i.e., increased knowledge and awareness, proenvironmental attitudes and behaviors) and the accountability movement, we explored the degree of correlation between school-wide adoption of a Green Schools program and student achievement in English language arts, mathematics, and science.

Maryland Green School Awards Program

Maryland Green Schools Awards Program (MDGS) was initiated in 1999 by the Maryland Association of Environmental and Outdoor Education (MAEOE) in cooperation with the state governor's office and Maryland Department of Natural Resources (MAEOE, 2014). The program recognizes K–12 schools that demonstrate a commitment to environmental education and sound environmental practices. Since the program's inception, over 460 Maryland schools have been certified as Green Schools at least once, and several have recertified multiple times.

Other states have enacted green schools programs, which focus on energy conservation, waste reduction, responsible transportation, greening school grounds, human health, and/or sustainable practices. The U.S. Department of Education's Green Ribbon Schools program honors schools exemplary in reducing environmental impacts and costs, improving student health and wellness, providing EE that incorporates STEM (Science, Technology, Engineering, and Mathematics), civic skills and green career pathways (USDOE, 2013). The MDGS program differs from other programs because it comprehensively integrates three areas: (a) enactment of environmentally integrated curricula, (b) installation of environmental management practices on school grounds, and (c) development of school–community partnerships. Action in these three areas comprises more than completing a checklist; they are intended to engender positive, sustained school-wide changes in knowledge, attitude, behavior, and action. Similar to the Belgrade Charter (UNESCO, 1975) and the Tbilisi Declaration (UNESCO, 1977), the MDGS program operationalizes EE based on its intended goals; these are to: promote knowledge and awareness of the environmental issues through integrated, hands-on inquiry; foster awareness of and concern about interdependence between human and natural systems; engender attitudes, behaviors, and commitments for a sustainable future; and engage youth in sustainable action projects. The MDGS program is particularly focused on place-based EE (Smith, 2007; Sobel, 2004)—educational opportunities focused on environmental issues relevant to students' local communities.

To receive MDGS certification, schools must provide students across grade levels with opportunities to study local environmental issues and appoint a collaborative green team of educators, parents, students, and facility managers who take demonstrable action in four of seven categories in the school's environmental management (i.e., sustainability practices) over a 2-year period. These categories include: water conservation, energy conservation, solid waste reduction, habitat restoration, and a healthy school environment. School-community partnerships work to enhance environmental curricula and support student environmental activism. By way of example, in one MDGS-designated elementary school, fifth grade students learned about water quality issues and effects of storm water runoff on the Chesapeake Bay watershed through several hands-on activities that included disciplinary literacy and mathematical practices such as reading informational text, representing and interpreting data, and engaging in argumentative writing and calculating storm water volume on campus. Students constructed watershed models to observe movement of particulate matter from terrestrial to aquatic systems, then used their knowledge to design and install a rain garden to promote slow percolation of water into soil during storm events.

Research Questions

This study aims to clarify the relationship, if any, between MDGS designation and student achievement on state-mandated standardized tests. Our major assumption was that variables of any individual school remain relatively constant over time, so comparing schools to themselves across time alleviates the impact of variables on individual schools. Under that assumption, we controlled for effects of student demographics and socioeconomic status (SES), school size, student–teacher ratio, parental involvement, teacher experience and opportunities for extracurricular environmental participation, and examined a more filtered relationship between MDGS designation and student achievement. The research questions were:

1. To what extent, if any, does MDGS designation correlate with student achievement in reading and mathematics in Grade 5 and Grade 8?
2. To what extent, if any, does MDGS designation correlate with student achievement in high school mathematics, English language arts, and biology?
3. At MDGS-designated schools, which demographic variables most strongly correlated with student performance on state-mandated standardized tests?

Literature Review

Prior research has indicated positive impacts of EE on students' knowledge of and attitudes towards the environment. Leeming et al. (1997) and Volk and Cheak (2003) demonstrated participation in environmental programs positively impacted students' knowledge of and attitudes toward the environment and were more effective in changing their parents' attitudes and actions towards the environment. McBeth and Volk's (2010) national survey of middle school students showed adolescents have moderately positive attitudes towards the environment and report a willingness to take positive environmental actions.

Despite empirical evidence from peer-reviewed research and data from program evaluations that suggests sustained, systemic EE results in proenvironmental and sustainability student beliefs, attitudes and actions, the realities of modern schooling dictate students' achievement in reading and mathematics take precedence over affective and attitudinal concerns. Alignment of EE's goals with the larger agenda of NCLB have been outlined in programmatic reports and empirical studies, which provide baseline data on the correlation between EE and student achievement. Lieberman and Hoody (1998) conducted an evaluation of student achievement across 40 U.S. schools which adopted programs using the environment as an integrating context (EIC). Students in schools with EIC programs performed better on standardized tests in reading and writing, math, science, and social studies. National Environmental Education & Training Foundation (NEETF, 2000) found significant improvement in students' reading and math scores, better performance in science and social studies, and increased student capacity to transfer knowledge to novel contexts and apply science skills flexibly. Lieberman et al. (2000) found that students in EIC settings scored higher on 73% of assessments in all content areas, including language arts, math, science and social studies than students in traditional settings. A follow-up program evaluation (Lieberman et al., 2005) showed similar performance trends.

Bartosh, Tudor, and Ferguson (2005) and Bartosh et al. (2006) found students participating in EE programs had significantly higher standardized test scores than non-EE students. However, overall patterns of performance over the 5-year study period were similar for EE and non-EE schools, suggesting other factors affected student achievement. High school students in EE programs were more likely to meet or exceed state averages on standardized tests of mathematics (Bartosh, 2006) and exhibit critical thinking (Ernst & Monroe, 2004). Volk and Cheak (2003) reported similar trends in fifth and sixth grade students.

Not all studies overwhelmingly or conclusively correlate EE programs with significant improvement in academic achievement. Wheeler et al. (2007) outlined strong evidence that EE can lead to significant improvement in math and science achievement, but limited or mixed evidence that EE bolsters social studies and language arts achievement. Clavijo's (2002) study of fifth and sixth grade students found EE did not correlate with any difference in science achievement, even when controlling for SES and prior science knowledge. Danforth (2005) compared standardized test scores of students who participated in a schoolyard habitats program versus nonparticipants and found math scores increased more on average for participating students than those in traditional classrooms, but reading scores decreased for both groups. Duffin, Phillips, Tremblay, & PEER Associates, Inc's (2007) evaluation of an elementary school CO-SEED (Community-Based School Environmental Education) program showed inconsistent patterns in correlations between students' participation and achievement in language arts, science, and math.

Although several research studies have suggested a positive correlation between participation in environmental education programs and student achievement, few have controlled for variables impacting the schools and students within their samples (Wheeler et al., 2007). Even fewer have controlled for the integrated effects these variables may have on students' achievement on standardized tests (Clavijo, 2002). Owing to the lack of corroborating evidence and few systematic empirical studies, contemporary EE lacks sufficient impact on current educational policy and practice (Ardoin, Clark, & Kelsey, 2013). Furthermore, few studies have controlled for factors such as SES, age, or level of achievement prior to EE participation (Wheeler et al., 2007). At risk is the ability of EE researchers and practitioners to advance an EE agenda that supports the development of pro-environmental behaviors while significantly improving student achievement. Our study attends to this need by providing empirical evidence on the relationship between a statewide green schools program and K–12 students' academic achievement.

METHODS

This study compared student achievement on state mandated standardized tests at Green Schools, pre- and post-MDGS designation. To do this, we compared standardized test pass rate in the 3 years immediately prior to and 3 years immediately following MDGS designation. The major assumption of this study was that schools tend not to change drastically in demographics from year to year, allowing data from each individual school across several years to be compared.

Participants

All public K–12 Maryland elementary (n = 41), middle (n = 7), and secondary (n = 9), private (n = 2) schools with MDGS designation in 2004–2007 were included. Each participant school had achieved and maintained green MDGS status for 3 years to be included in the data set.

Data Collection and Analysis

Using information from the Maryland State Department of Education's (MSDE, 2013) Web site or individual school Web sites, we compiled data for each school on student demographics and attendance rates, percentages of students scoring proficient or advanced on each standardized test, school size, student–teacher ratio, rates of teacher certification, average class size, PTA presence and size, and presence of environmental club. Any data not available through MDSE or individual school Web sites were collected through phone contact with building administrators. Both elementary and middle schools administered the Maryland School Assessment (MSA) in reading and mathematics, and high schools administered separate High School Assessments (HSA) in algebra, biology, and English. Because the same subject-area assessments (i.e., English and mathematics) were administered in Grade 3 through Grade 8, we placed elementary and middle schools into a single category for analysis. Based on state indicators, student performance on the MSA and the HSA are divided into three levels of achievement: basic, proficient, and advanced. Student performance in the basic level indicates more work needed for those students to attain proficiency of learning standards. Proficient and advanced categories, considered acceptable levels of achievement based on state standards, indicate student performance were at acceptable and exemplary levels, respectively. Demographic data were subjected to ordination analyses (using PC-ORD software) to ascertain correlations among variables. Initially, test score data were tested and found to meet assumptions for equal variance and normality. Then, using SPSS V19 (SPSS, 2013), data were subjected to a bivariate correlation test to determine correlations among all variables. Test scores were also analyzed in SPSS using paired t-tests.

Table 1
Differences in mean percentage pass rate on state-mandated standardized tests, pre- and post-Maryland Green Schools Awards Program designation

	Mean Percentage Pass Rate[a]			
	Pre	Post	t(df)	p
5th and 8th Grade reading	82 (11)	87.8(9)	9.50(49)	.00
5th and 8th Grade mathematics	79.4(15)	85 (12)	7.61(49)	.00
10th Grade algebra	47.5(22)	60.3(23)	2.92(8)	.02
10th Grade English	56.4(21)	64.5(19)	3.95(8)	.004
10th Grade biology	57.6(26)	65.5(22)	1.84(8)	.10

Note. Standard deviations appear in parentheses below each mean.
[a]Pass rate includes students who scored in either proficient or advanced categories.

RESULTS

When comparing overall outcomes, students enrolled in Green Schools showed increased performance on all content area assessments across the study period (see Table 1), all of which were significant except for biology. Performance by fifth and eighth grade students on the MSA reading and mathematics assessments significantly increased from pre- to post-MDGS designation (see Fig. 1). Likewise, performance on high school algebra and English assessments were significantly higher on the post-MDGS than the pre-MDGS designation (see Fig. 2). Differences in high school student achievement on HSA biology assessment were not significant. This may be due to the amount of environmental science-based material routinely represented on this assessment. Only 10% of online HSA biology sample tests from 2004–2009 contained covered environmental concepts.

While aggregate scores across schools indicated positive correlation between MDGS designation and student achievement, when difference scores were compared against demographic variables of the student population, results were mixed (see Table 2). Schools 1 and 2, with high proportions of students from low SES, minority backgrounds had high percentage difference scores in all three subject areas: algebra, biology and English. School 7, with a heterogeneous student population, also had percentage difference scores

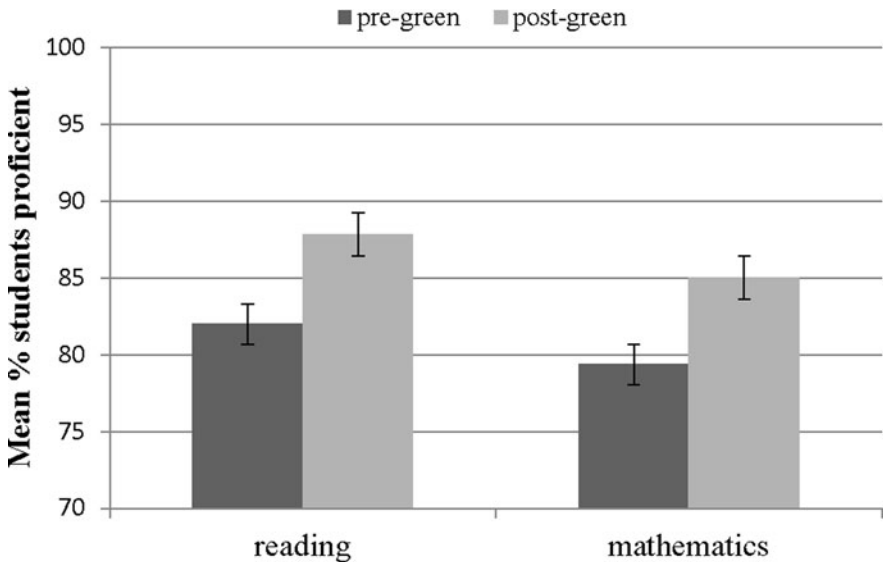

Fig. 1. Mean percentage pass rate for elementary and middle school students, pre- and post- Maryland Green Schools Awards Program designation.

greater than one standard deviation. Although School 8 had a heterogeneous student population, a majority from low SES backgrounds, percentage difference scores were not greater than one standard deviation in any subject. Schools 3, 4, 5 and 9, with majority White student populations, showed less or no percentage differences in test performance. While

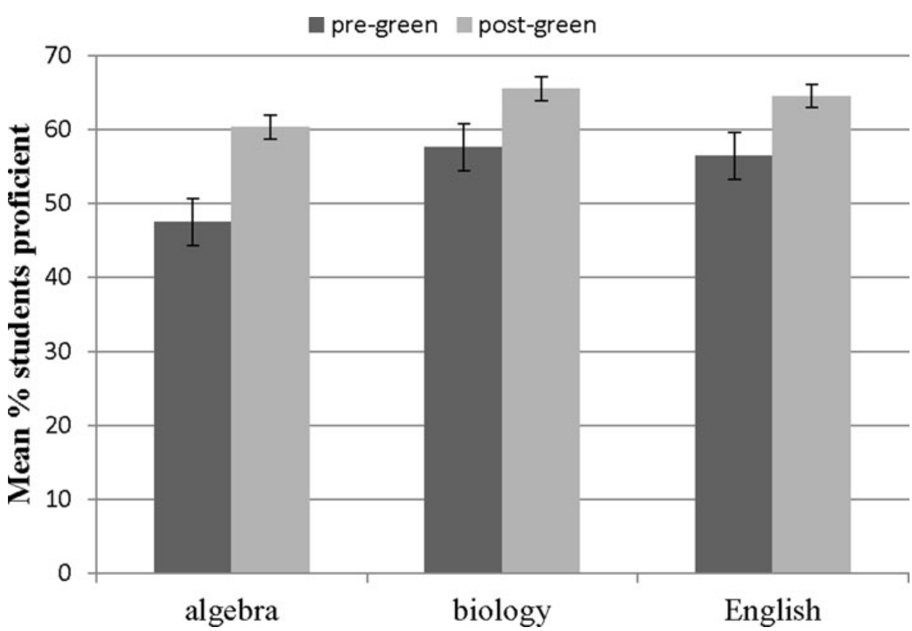

Fig. 2. Mean percentage pass rate for high schools pre- and post- Maryland Green Schools Awards Program designation.

Table 2
Demographics and percentage difference scores for individual high schools

	High school								
Demographics[a]	1[c]	2[d]	3	4	5	6	7	8	9
Asian	2.5		1.7	2.5		4.1	10.5	4.7	1.6
Black/African American	24.5	95.6	3.0	2.6	1.6	6.8	26.9	37.9	22.8
Hispanic/Latino	9.9		3.7	2.5	4.2	3.9	12.9	53.5	3.3
White	60.9		90.4	90.9	91.3	81.7	43.9	3.2	67.2
Two or more races	1.9		1.2	1.3	2.7	3.4	5.5	0.5	5.0
FARM[b]	48.6	78.8	5.6	< 5.0	12.9	6.8	12.0	53.4	14.5
	% Difference Score								
Algebra	31.2*	20.35*	18.45*	0.1	22.45*	−6.05	23.75*	0.15	4.75
Biology	16.8*	30.25*	10.2	−9.2	16.55*	−4.6	13.45*	−3.0	0.35
English	6.25*	18.75*	9.7	−.01	4.85	0.65	14.55*	10.7	7.4

[a]Race/ethnicity indicators presented as percentage of total school population. [b]Proportion of total school population receiving free and reduced price meals. [c]1.23% of school's population identified as American Indian. [d]4.4% of school's population unidentified by race.
*Difference greater than 1 *SD*.

this may suggest the MDGS program is differentially effective in specific schools, there may be impacts beyond those illustrated by standardized test scores. However, those potential correlations are beyond the scope of this study. Although we compared each school against itself to alleviate the impact of demographic variables, it remains a reality that schools across the state exist with varying conditions.

To determine if school-level demographic variables were correlated with standardized test performance, we ran an ordination analysis. Ordination of variables indicated level of teacher certification was highly correlated with percent population of minority students in particular schools (see Fig. 3). In addition, correlational analyses indicated student–teacher ratio was highly correlated with student achievement for pre-MDGS designation in high schools in two of the three subject areas: algebra $r = 0.72$, $p < .05$ and biology $r = 0.74$, $p = < .05$; (English $r = 0.66$, $p = .052$), while this correlation was not present post-MDGS designation (algebra $r = 0.37$, $p =$ n.s; biology $r = 0.47$, $p =$ n.s; English $r = 0.51$, $p =$ n.s). Finally, there was high negative correlation between percent noncertified teachers and student performance on HSA biology in pre-MDGS designation ($r = -0.71$, $p < .05$), but this was not as strong for the post-MDGS designation ($r = -0.53$, $p =$ n.s). One interesting finding is the high correlation between number of noncertified teachers and low scores on biology HSA in schools prior to MDGS designation. This correlation was weaker for post-MDGS designation, which may indicate integrated EE curricula eases the negative impact of less certified biology teachers on student learning.

DISCUSSION

In this study, we do not attempt to conclude that MDGS certification was the causal factor in improving students' achievement in our sample; however, our findings point towards a positive correlation between student achievement on standardized tests and MDGS designation. Findings from this study support prior research on the relationship between environmental education and academic achievement (Bartosh et al., 2006, 2009, 2010; Volk and Cheak, 2003).

Although student achievement in schools post-MDGS designation was significantly greater than pre-MDGS designation, overall gains in proficiency could be viewed as modest

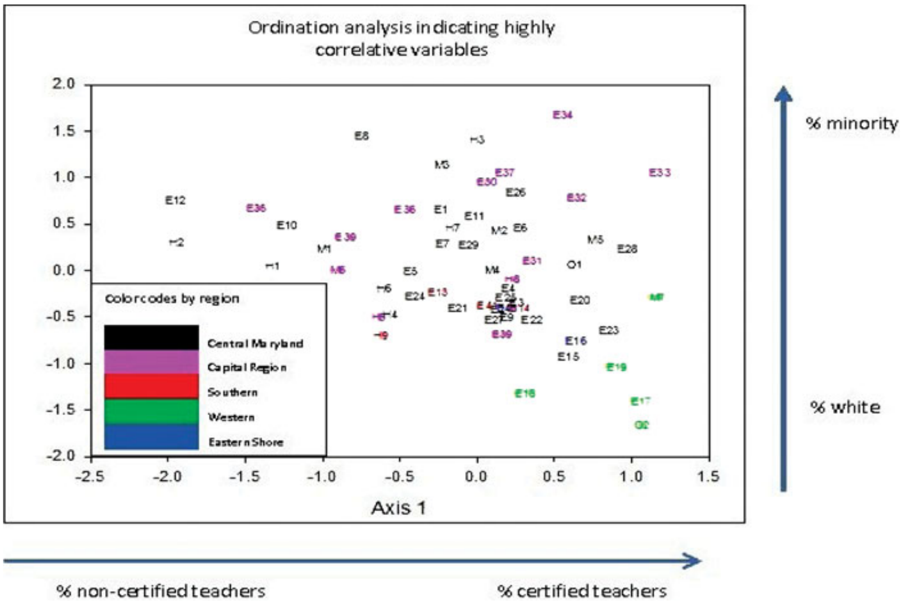

Fig. 3. Ordination of variables integrated with state region.

at best. Overall, fifth and eighth grade students' reading scores increased from 82% to 88% pre- to post-MDGS designation. Although statistically significant, one could argue the percentage of students scoring proficient or advanced was already high, and a gain of six percentage points represents only a marginal increase in percentage of students scoring proficiently. Arguably, some schools contained high achievers even in the pre-MDGS condition; others did not. Likewise, when considering high school achievement in math, English language arts, and science, statistically significant gains in mean percent pass rate in post- versus pre-MDGS designation indicate positive correlation between student achievement and MDGS designation. These gains are tempered by the reality that mean percentage scores for schools hovered between 60% and 66% of students scoring proficient or advanced, thus nearly 40% of the student population was still not proficient all three subject areas even after their schools received MDGS designation.

Despite modest gains in student achievement in this study, some characteristics of the MDGS program may be effective for supporting student learning in core disciplines. First, it inherently engenders place-based education. Through EE-integrated instruction, Maryland students engage in problems and issues relevant to communities or region in which they reside (Gruenewald, 2005), such as Chesapeake Bay water quality and fisheries health or soil conservation in the Piedmont region. Using place-based environmental education has the capacity to break through the constraining regularities of normative, homogenized standardized classroom curricula. Students are more motivated to learn when the topics and issues related to learning are connected to their communities and economic, social, political, cultural, and natural resources within those communities (Smith, 2007) and to take sustainable action that will afford use of these resources for generations to come. Second, the MDGS program emphasizes student-driven inquiry, problem-solving skills, and field studies (Hart, 2007; Winther, Sadler, & Saunders, 2010). Instructional and pedagogical strategies that contextualize content learning in relevant problems and issues and engage students in collaborative investigation have been shown to enhance student engagement, reduce classroom disciple problems and increase academic achievement (Crawford, Krajcik, & Marx, 1999; Marx et al., 2004).

It is possible student achievement gains observed in this study were the result of teacher expectancy bias? We argue that it is unlikely for the following reasons. First, integration of EE into classroom instruction is a state mandate, not a choice. In 2011, the MSDE approved environmental education standards for grades K–12. With these standards in place, engaging students in environmental study is required by state policy alongside NCLB mandates for benchmarks in student achievement. All students graduating from Maryland public high schools are expected to learn about integrated environmental issues and to engage in sustainability action projects across their K–12 education. Although Maryland EE standards are mandated in K–12 education, schools have autonomy to choose how to integrate EE standards into curriculum and instruction. Certainly, it is anticipated the enactment of these EE standards will catalyze concomitant increase in school applications for MDGS certification; however, application and continuous recertification for MDGS designation is *not* required by state EE policy. Second, no physical oversight or accreditation visitation at schools exists. Adherence to the requirements for certification by schools is documented through self-reports by each school's green team, which generally constitutes a core group of teachers, administrators, parents, and support staff and is responsible for spearheading EE curriculum integration and managing campus sustainability practices. The majority of teachers at any particular MDGS school merely provide the green team with documentation of EE curricular integration. While MDGS designation is confirmation of EE integration in schools, it is not verification of full endorsement by the entire teaching faculty at any particular school.

The results of this study indicate the MDGS program, which supports integration of EE curricula and action projects on sustainability in schools, is positively correlated with student achievement in English language arts and mathematics. One conclusion that could be drawn from the lack of difference in student achievement in science is that standardized testing in science needs to be more tightly aligned with the state's EE standards. In particular, Maryland HSA exams need adequate alignment with state-mandated EE standards. If EE instruction is integrated across disciplines in K–12 education, closer alignment between content standards, classroom instruction, and standardized tests enhances content and construct validity of exams (Messick, 1994).

This study must be interpreted within certain limitations. First, this study used readily available standardized test performance as a measure of academic achievement. Researchers debate the efficacy of standardized testing outcomes for accurately and fairly measuring students' environmental knowledge, skills, and attitudes. Gruenewald and Manteaw (2007) contended the purposes of EE are incommensurate with the accountability movement through which standardized testing is rationalized. By using standardized test scores to legitimize environmental education undermines transformative aims of EE, specifically, promoting ecological literacy and attitudes and behaviors oriented towards sustainability (Gruenewald, 2004). Moreover, statistical processes for measuring student achievement disproportionately label minority students from low SES backgrounds as failing or lacking ability (Kim & Sunderman, 2005).

Using correlational analyses for analyzing relationships between variables has limitations. The purpose of correlational research is to discover relationships between variables, not to establish causation. While our study indicates a positive correlation between MDGS designation and student achievement on standardized tests, we cannot definitively conclude EE instruction was the sole contributor to increased student achievement. Nonetheless, our findings support Ernst and Monroe (2004) who suggested effective approaches to

EE are systemic, multiyear programs with cross-disciplinary integration.

Additional research might be undertaken to determine the extent to which schools integrate the hallmark characteristics of the MDGS program, which are student-centered, hands-on inquiry into EE topics and issues, and school action projects that promote environmental sustainability. Focused case studies in a select number of MDGS schools that have received initial and recertification might reveal nuances in school and classroom contexts that either support or hinder student academic achievement.

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