

Outdoor Learning Centers Develop Positive Student Attitudes Toward Science

John Hoffman

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Abstract

The goal of the project is to help support an Ohio Environmental Education Fund Grant creating outdoor learning centers and sponsoring professional development of teachers in inquiry-based learning (IBL) by exploring the relationship between outdoor learning centers and students' attitudes toward science. Research shows that professional development of teachers and their attitude toward change reflects a culture that is "investigative" in nature (Supovitz and Turner, 2000). Outdoor learning centers and IBL are at the periphery of that reform. Will students who have some exposure to outdoor IBL learning centers have a more positive attitude toward science than students without exposure to outdoor learning centers? I predict students will have a more positive attitude toward science, and that they then may be more likely to pursue studies in science, technology, engineering or math. The presence of outdoor learning centers (OLCs) alone will not develop those positive attitudes; OLCs used by teachers with professional development in facilitating IBL, and teachers with a positive attitude toward IBL will promote improved attitudes towards science in their students. Surveys given to students in schools with and without outdoor learning centers will be used to assess attitudes. Students, especially in grades 5 – 8, in schools with OLCs do have a more positive attitude toward science.

Introduction

The question was created from an opportunity my company (Alloway) and I have to partner with local schools in an Ohio Environmental Education Fund Grant. The project title of the grant is *Linking and Engaging Through Outdoor Learning Centers*. The project description is "to link 2197 students in four Allen County School systems through a collaborative community effort to create and integrate outdoor learning centers where students can engage in discovery and inquiry based learning (IBL)... Training of teachers and community members will enhance the educational impact and continuation of the four outdoor learning centers" (Appendix I). Our role in the partnership is to assume some of the professional development of teachers under the direction of the professional development manager at Rhodes College. The grant requires approximately 10 professional development programs, many of which will be developed and presented by Alloway and myself.

The purpose of the OEEF grant is to provide funding to create outdoor learning centers to engage teachers and students in inquiry based learning with the ultimate goal of more students pursuing studies in science, technology, engineering, and math (STEM). The goal of this IAP project is to establish a correlation between schools with and without outdoor learning centers, and attitudes toward science. Will students who have some exposure to outdoor IBL learning centers have a more positive attitude toward science than students without exposure to IBL outdoor learning centers? I predict they will. The action component, or follow-up to this project, will be to assess the effectiveness of the grant, which extends over the next 2.5 years, as determined by increased positive attitudes toward science. The focus will shift and compare student attitudes in the schools with the grant now and after 2 years. Will the professional development of teachers and full implementation of the OLCs see improved attitudes

toward science? The same survey administered to students in the schools participating in the grant will be given again at the end of this school year, and at the end of next school year. This IAP project will serve as a baseline study for my Global Field Masters Program.

What we feel and do are indicators of our tendency to pursue a goal. Students with positive attitudes toward science may be more likely to pursue STEM studies, especially if reinforced by positive behaviors (i.e., recycling, conserving water, or other environmentally responsible actions). According to Papanastasiou (2002) attitude is an “emotional tendency, either positive or negative, of an individual towards objects, people, places, events and ideas”. Attitudes are based upon emotions. They are a result of how we feel about something. Feelings include likes and dislikes as well as boredom and interest. We gain insight into those feelings in a number of ways. Students asking questions that lead to more questions are indicative of interest in the subject, which is positive (Pfouts, et al 2003). Behaviors also provide some insight into feelings and may be indicators of attitude.

The benefits of outdoor learning centers are clearly established. They challenge students and provide opportunities for learning in real world settings. They provide opportunities for learning by inquiry and facilitative teaching that cannot be replicated in a classroom (Pfouts, et al 2003). Outdoor learning centers complement classrooms in a synergistic way, bringing activities together while fostering an appreciation for nature (Tanner, 2001). Fundamental process skills such as observing, predicting, questioning, designing experiments are effectively taught in outdoor learning centers, and inquiry must be part of the process for teaching science (Duran, et al 2010).

Outdoor learning centers create opportunities to nurture positive attitudes toward science to some extent. Just having an outdoor learning center does not mean the maximum benefit is being achieved. It must be used, and the professional development of teachers is an important criteria. It is given significant emphasis in the grant with detailed performance specifications. Ten professional development programs are expected, and they must relate to IBL and use of the outdoor learning center. Research supports the necessity of teacher professional development. Teachers must be prepared to learn and subscribe to a doctrine of knowledge creation. Furthermore, teachers must be practiced in the skills of inquiry to effectively help children learn through inquiry (Catapano, 2005). Research shows student attitudes toward science are strong in the 6th grade and they weaken through high school (Duran and Ozdemir, 2010). This is supported by other researchers as well (Papanastasiou, 2002). Implementation of OLCs by teachers trained in IBL may help reverse this trend.

Methods

A student survey (Appendix II) was used to measure student behaviors and attitudes. The survey was given to lead teachers in three schools participating in the Ohio Environmental Education grant program to give to their classes. All of these schools have outdoor learning centers and advanced inquiry tools provided by the grant. Use of the OLCs and the tools provided are unknown. For comparison purposes, the survey was given to teachers in schools without access to outdoor learning centers. The survey was

carefully designed to assess attitudes. Questions are structured in a way to obtain measureable responses as to their likes and dislikes. Students are asked to rate their feeling toward science and math. Other subjects are included so as not to incur bias in the study. They are also asked to rate activities such as taking a nature hike, or collecting and studying insects. A student who loves to study insects is probably passionate about science. Other activities were embedded in this section as well to create a well-rounded selection of likes and dislikes. Some questions assess conservation behaviors and were included as part of a Conservation Science class project. Some of those questions are not germane to this IAP project.

A significant number of survey responses were obtained. There were approximately 175 responses each from schools with and without OLCs. There was a more diverse set of grades represented by the schools in the grant, and it was easier logistically to coordinate this part of the project. The teachers are all local, and we met periodically as part of the grant requirements. It was logistically more difficult to get a cross section of grades. This is given full consideration in the presentation and evaluation of the data, and there was sufficient data to compare the same grade levels in both types of schools represented. Also, there was sufficient data to evaluate within the OLC schools differences in attitudes between grades 5-8 and 9-12. Therefore the data is presented in a number of tables.

Summary statistics are provided for most of the data sets. Number of responders, pertinent information about the responders, means and standard deviations are tabulated. The variance of data was evaluated using the F test, and based upon equal or unequal variance, the appropriate T test was used to establish whether or not there was a statistical difference between data sets. This approach was used to directly address the comparative question.

Results

It was relatively easy to get a cross section of responses from 5th graders thru seniors in the schools with OLCs since these schools are local and we personally interact with the lead teachers. It was more challenging to get a good cross section in the schools without OLCs. There were a similar number of responses in each.

Table 1. Demographic data of survey responders

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	171	178
5 th graders	20	0
6 th graders	17	68
7 th graders	17	40
8 th graders	24	70
9 th graders	23	0
10 th graders	28	0
11 th graders	26	0
12 th graders	16	0
male	57%*	54%**
female	42%*	45%**

* one non-responder *two non-responders

Tables 2 -4 summarize the data from survey question 2 asking responders to rate their feelings about going on a nature walk. Comparative data from all responders between schools with and without OLCs is presented. Comparative data is also presented just from grade 5-8 responders between schools with and without OLCs. Finally, comparative data is presented from grade 5-8 and 9-12 responders in the OLC schools.

Table 2. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Go on a nature walk”**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	170	174
Grade levels of responders	5 - 12	6 - 8
Average rating	3.394	3.402
Standard deviation	1.311	1.312
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.9539*	

Data presented is for all responders.

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 3. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Go on a nature walk”**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	77	174
Grade levels of responders	5 - 8	6 - 8
Average rating	3.2857	3.402
Standard deviation	1.5799	1.312
Variance (determined by F Test)	Unequal Variance	
T Test (p value)	0.5719*	

Data presented is for grades 5 – 8 to compare responses between similar age groups

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 4. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Go on a nature walk”**

Data	Schools with Outdoor learning centers Grades 5-8	Schools with Outdoor learning centers Grades 9-12
Total survey responses	77	93
Average rating	3.2857	3.4839
Standard deviation	1.5799	1.0385
Variance (determined by F Test)	Unequal Variance	
T Test (p value)	0.3467*	

Data presented to determine if there is a statistical difference in responses between grades 5-8 and 9-12 in the schools with OLCs for this question.

*There was no statistical difference between responses at alpha 0.05.

Tables 5 - 7 summarize the data from survey question 2 asking responders to rate their feelings about collecting and studying insects. The same comparisons are made as for tables 2-4.

Table 5. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Collect and study insects”**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	167	171
Grade levels of responders	5 - 12	6 - 8
Average rating	2.1976	2.0760
Standard deviation	1.3228	1.1783
Variance (determined by F Test)	Unequal Variance	
T Test (p value)	0.3733*	

Data presented is for all responders.

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 6. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Collect and study insects”**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	75	171
Grade levels of responders	5 - 8	6 - 8
Average rating	2.3333	2.0760
Standard deviation	1.5186	1.1783
Variance (determined by F Test)	Unequal Variance	
T Test (p value)	0.1945*	

Data presented is for grades 5 – 8 to compare responses between similar age groups

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 7. Survey Question 2: Rate each activity on a scale of 1-5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do. **“Collect and study insects”**

Data	Schools with Outdoor learning centers Grades 5-8	Schools with Outdoor learning centers Grades 9-12
Total survey responses	75	92
Average rating	2.3333	2.0870
Standard deviation	1.5187	1.1354
Variance (determined by F Test)	Unequal Variance	
T Test (p value)	0.3467*	

Data presented to determine if there is a statistical difference between grades 5-8 and 9-12 in the schools with OLCs for this question.

*There was no statistical difference between responses at alpha 0.05.

Tables 8-10 summarize the data from survey question 5 asking responders to rate their feelings about math. The same comparisons are made as for tables 2-4.

Table 8. Survey Question 5: Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Math"**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	171	178
Grade levels of responders	5 - 12	6 - 8
Average rating	3.4152	3.2697
Standard deviation	1.4380	1.4322
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.3442*	

Data presented is for all responders.

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 9. Survey Question 5: Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Math"**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	78	178
Grade levels of responders	5 - 8	6 - 8
Average rating	3.6282	3.2697
Standard deviation	1.3685	1.4322
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.0629*	

Data presented is for grades 5 – 8 to compare responses between similar age groups

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 10. Survey Question 5: : Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Math"**

Data	Schools with Outdoor learning centers Grades 5-8	Schools with Outdoor learning centers Grades 9-12
Total survey responses	78	93
Average rating	3.6282	3.2366
Standard deviation	1.3686	1.4773
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.0760*	

Data presented to determine if there is a statistical difference between grades 5-8 and 9-12 in the schools with OLCs for this question.

*There was no statistical difference at alpha 0.05.

Tables 11-13 summarize the data from survey question 5 asking responders to rate their feelings about science. The same comparisons are made as for tables 2-4.

Table 11. Survey Question 5: Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Science"**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	170	178
Grade levels of responders	5 - 12	6 - 8
Average rating	3.6000	3.5899
Standard deviation	1.2517	1.2466
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.9399*	

Data presented is for all responders.

*There was no statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 12. Survey Question 5: Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Science"**

Data	Schools with Outdoor learning centers	Schools without Outdoor learning centers
Total survey responses	77	178
Grade levels of responders	5 - 8	6 - 8
Average rating	3.9481	3.5899
Standard deviation	1.2019	1.2466
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.0342*	

Data presented is for grades 5 – 8 to compare responses between similar age groups

*There was a statistical difference at alpha 0.05 between responses from schools with OLCs and those without OLCs.

Table 13. Survey Question 5: Rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like. **"Science"**

Data	Schools with Outdoor learning centers Grades 5-8	Schools with Outdoor learning centers Grades 9-12
Total survey responses	77	93
Average rating	3.9481	3.3118
Standard deviation	1.2019	1.2246
Variance (determined by F Test)	Equal Variance	
T Test (p value)	0.0008*	

Data presented to determine if there is a statistical difference between grades 5-8 and 9-12 in the schools with OLCs for this question.

*There was a statistical difference at alpha 0.05.

Table 14 summarizes the data from a Conservation Science project using a survey to measure conservation values between teachers in schools with OLCs and those without.

Table 14. Comparison of teacher responses in areas reflecting "Strong Agreement" in schools with and without outdoor learning centers.

Area	Strongly Agree (%) Outdoor learning centers*	Strongly Agree (%) No outdoor learning center**
Biodiversity is important to quality of life	85.7	78.3
A cash value can be placed on nature.	0.0	4.3
We have a responsibility to protect our Environment for the future	100.0	82.6
Children should be exposed to the outdoors	100.0	91.3
The US park system should be expanded	71.4	60.9
Recycling should be mandatory	85.7	60.9
Increasing fuel efficiency...top priority	85.7	65.2
Every species plays important role...	85.7	82.6

• 7 responders, **23 responders

Discussion

The demographic data (Table 1) reveals a disparity in the composition of responders between schools with OLCs and those without OLCs. Survey responses from the schools with OLCs were received first. Three of the four schools participating in the grant submitted responses. We worked personally with the lead teachers and these teachers polled their students very quickly. Responses represented grades 5-12. It took more time to contact teachers in other schools systems not involved with the OEEF grant. Therefore, survey responses from schools without OLCs took longer to receive and evaluate. Of the four schools participating, one was local and three were from other districts. Participating teachers in those schools were prior Earth Expeditions classmates. Their assistance was much appreciated. Responses from those four school represented grades 6-8. The disparity of data is addressed directly in the comparisons chosen and the evaluation of those comparisons.

The survey instrument (Appendix II) was developed to measure behavior and attitudes towards conservation and science. The survey was somewhat broad in nature so that responses might be useful in related projects, especially the Conservation Science class. Another thought behind the development of the survey considered having sufficient data to correlate attitudes behind conservation and science. For this project, however, select responses were extracted to specifically measure attitudes toward science. Two activities were selected from Question 2 (Rate each activity on a scale of 1 – 5, where 1 is an activity you would hate to do, 3 is something you would not mind doing, and 5 is something you would love to do). The two activities felt to reflect an attraction or liking to science were going on a nature walk, and collecting and studying insects. These two

activities were embedded with eight other activities. Question 5 (rate each subject on a scale of 1-5, where 1 is a subject you dislike, 3 is a subject you don't mind, and 5 is a subject you really like). Math and science were the relevant subjects. Responders rated four other subjects as well. The use of a question asking responders to rate eight activities and six subjects were designed to reduce bias.

A preliminary evaluation of all responders was performed. Tables 2 (nature walk), 5 (insects), 8 (math), and 11 (science) present that data. There was no statistical difference between responders from schools with OLCs and those without. The p values for the T Test were all well above 0.05 (and 0.10) and had it not been for the disparity in classes represented, it might seem there was no difference in responses. Given the disparity, another approach was pursued.

Fortunately, there was sufficient data to compare responses from like grade levels. There were significant responses from the schools without OLCs in grades 6-8 and from the schools with OLCs in grades 5-8 to compare. Tables 3 (nature walk), 6 (insects), 9 (math), and 12 (science) present that data. There was not a significant difference in responses from the activities (nature walk and studying insects). However, there was a statistical difference in math at an alpha value of 0.1 ($p=0.0629$). There was also a statistical difference in science at an alpha value of 0.05 ($p=0.0342$). There seems to be a significant difference in attitudes toward science (and math) between the grades represented through 8th grade in schools with OLCs and those without.

The data available presented a unique opportunity to explore differences in attitudes between grades 5-8 and 9-12 within the same type schools (those with OLCs). Tables 4, 7, 10, and 13 present that data. Again, there was not a significant difference in responses from the activities. However, there was a statistical difference in math at an alpha value of 0.1 ($p=0.0760$). However, there was a statistical difference in science at an alpha value of 0.05 ($p=0.0008$). This supports the findings of research cited earlier (Duran and Ozdemir, 2010) that attitudes weaken in high school.

There are more questions raised than answered by this IAP project. This study is based on a limited number of responses. Data can be evaluated based upon grade, gender, and even the type of school. The three schools in the OEEF program were all very different. One school was a rural, county school; one school was a city school; one school was a private school. More data is would improve the quality of the findings. Have the schools with outdoor learning centers actually used the learning centers? It would appear at this stage of the grant creating the learning centers and providing professional development opportunities for teachers, that there has been minimal exposure to the learning centers themselves, and perhaps the inquiry tools as well, although all of the schools have installed and are using the weather stations. Teacher conservation values might be a factor as well.

Teacher conservation values may very well have an impact on students' attitudes toward science. Having access to outdoor learning centers may contribute to positive conservation values by teachers perhaps because of the awareness created by these centers. Research conducted in Conservation Science for Community Environmental

Lab 1 supports this contention. The goal of my CEL-1 research was to measure and compare conservation values held by teachers in schools with access to outdoor learning centers and those without the centers using a teacher survey (Appendix III). Table 14 summarizes data from a teacher survey given through Survey Monkey. Although more data would better support these findings, preliminary findings show stronger conservation values in teachers in schools with outdoor learning centers. However, it is not clear if a) there is enough data to even support that conclusion b) teachers with higher conservation values actively seek opportunities to create and use OLCs and c) the presence of OLCs stimulate conservation values.

Conclusions

The findings suggest students in grades 5-8 in schools with OLCs have a more positive attitude toward science and math. There was insufficient data to distinguish between all grade levels, and more data would help substantiate the findings. This study supports prior research (Duran and Ozdemir, 2010 and Papanastasiou, 2002) showing student attitudes toward science weaken from grade school to high school. More data to include all grade levels in schools without OLCs and schools with a history of actually having used OLCs would be the most significant improvements.

Action Component

The action component will be to assess the effectiveness of the grant. The grant extends over the next 2.5 years. The primary determinant will be attitudes toward science. Three of the four lead schools in the OEEF grant will form the nucleus of the project. The focus of the action component will shift somewhat from comparing schools with and without outdoor learning centers to comparing the attitudes of students in schools participating in the grant now and after two years. This project will serve as a baseline study for my Global Field Masters Program. What difference will the use and implementation of outdoor learning centers make in student attitudes toward science in conjunction with professional development of teachers in inquiry and maximizing the use of the outdoor learning centers.

The student survey will be given again at the end of this school year to students in participating schools. The survey will also be given at the beginning and end of the next school year. Follow-up teacher surveys will be given to assess teacher attitudes toward science and professional development related to inquiry and science.

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Appendices

Appendix I

OEEF Grant

Appendix II

Student Survey

Appendix III

Teacher Survey