An Evaluation of the Project Learning Tree Secondary Curriculum: *Exploring Environmental Issues in Places We Live*

Abstract

The Project Learning Tree curriculum *Exploring Environmental Issues in Places We Live* was evaluated using a quasi-experimental research design that consisted of pre/post intervention assessments measuring differences in self assessed content knowledge, researcher assessed content knowledge, and attitudes. Treatment groups consisted of two randomly assigned groups, one group completed 3 lessons and the other group completed 6 lessons. Analysis indicated the six lesson treatment group demonstrated significant gains in all three categories, while the three lesson group exhibited significant gains in self assessed content knowledge. The results suggest that the curriculum is valuable in delivering place-based educational content.

Key Words: environmental education, place based education, environmental issues, environmental attitudes

Introduction

In 2006, Project Learning Tree, a division of the American Forest Foundation, launched a new secondary curriculum module, *Exploring Environmental Issues in Places We Live*. The purpose of this module is to provide opportunities for community investigations that focus on environmental, social, and economic issues, and help students and other community members develop and strengthen their sense of place.

The Places We Live module is composed of eight activities that emphasize place based educational concepts. Activities need not be completed as a set; each activity can act as a "stand alone" lesson. To provide a sense of the flow of lessons and the content covered in each activity, a brief description of each activity follows.

Activity Descriptions

In activity one, *Personal Places*, students investigate and report on their connection with a special place and with their greater community. In the second activity, *Community Character*, students explore community character and investigate the ways that communities, including their own, are responding to growth and development pressures. Activity three, *Mapping Your Community Through Time*, asks student teams investigate the social, cultural, economic, aesthetic, and environmental components of their community to create map overlays and reports describing the development of their community through time. The fourth activity, *Neighborhood Design*, has students explore the current design of their neighborhood, critically evaluate a variety of development options, and formulate ideas for guiding further change or growth in their neighborhood. In activity five, *Green Space*, students investigate green infrastructure and native plant communities at the neighborhood, community, and regional scales and then explore the dual needs of accommodating population growth while protecting green space and native plant communities. In *A Vision for the Future*, the sixth activity, student teams develop and present a vision for the future of an area in their community. Activity seven, *Far-Reaching Decisions,* asks students to develop graphic organizers and creative presentations to illustrate how individual decisions can impact the local environment, as well as distant communities. They also measure their own ecological footprint. In the final activity, *The Ogallala Aquifer*, students investigate a regional issue as they adopt the roles of shareholders and debate solutions to the depletion of North America's largest aquifer.

Curriculum rationale

The reasons behind choosing this topic as the basis for the curriculum were many. Place-based education, such as that demonstrated by the module, uses the environment as an integrating context (EIC) across disciplines (Lieberman & Hoody, 1998). Place-based education

is characterized by exploration of the local community and its surroundings, and hands-on experiences of environmental discovery and problem solving. Research shows that using this approach results in many benefits to students, such as enhanced critical thinking skills (Ernst & Monroe, 2004), greater motivation to achieve in the classroom (Athman & Monroe, 2004), reduced classroom disruption and disciplinary problems (NEETF 2000; SEER 2000; Lieberman & Hoody, 1998; Falco, 2004), and a greater sense of responsibility and stewardship towards the environment (Bartosh, 2003). Duffin et al. (2004) report that exposure to EIC programs leads to a greater attachment to place, more time spent outside, increased civic engagement, and environmental stewardship. The Places We Live module was written to maximize the benefits demonstrated by the research, and was designed to meet several objectives. First, completion of the module activities was expected to provide students with the skills and knowledge required to be active participants in shaping their community. Second, by completing the module activities it was expected that students would be more connected to the places they live (or the connections would be highlighted) so they will care about and influence the decisions being made about those places. Third, the designers of the Places We Liver curriculum expected the module would make students aware of environmental, social, and economic issues connected with community growth and change. Finally, it was hypothesized that completion of the modules would demonstrate to students that their choices impact the environment and the quality of life in communities near and far.

While these objectives were thought to have been adequately covered with the curriculum, the extent to which they were supported was not evident. Therefore, we designed a national study of the curriculum that quantified the extent to which the completion of the curriculum resulted in student attitudes and content knowledge about the places they live. This

quasi-experimental research design seeks to determine the extent to which the Places We Live curriculum facilitates a change in students' self-assessed knowledge, researcher assessed content knowledge, and attitudes toward the places they live. Our research questions are:

- Does exposure to the Places We Live module result in a change in environmental attitudes with respect to the students' community?
- Does exposure to the Places We Live curriculum result in greater researcher-assessed content knowledge with respect to the issues covered in the curriculum, compared to other similar curricula?
- Does exposure to the Places We Live curriculum result in greater self-assessed content knowledge with respect to the issues covered in the curriculum, compared to other similar curricula?

Methods

This quasi-experimental research design seeks to determine the extent to which the *Places We Live* curriculum facilitates a change in students' self-assessed content knowledge, researcher assessed content knowledge, and attitudes toward the places they live. Since the students have already been assigned to a class in their school, and it is not feasible to randomly assign students to a different class, an experimental research design was not possible. Thus, a quasi-experimental research design was implemented, wherein teachers were selected to participate in the study with two of the classes they taught during the 2007-2008 school year.

Sampling

Teachers that have had experience with the *Places We Live* curriculum were invited to participate in the study. Teachers were also recruited at national science education conferences. We sent invitations to participate to 20 teachers. All teachers agreed to participate but only 13

(65% response rate) completed all of the study requirements, including pre- and posttest data collection.

Each teacher volunteered to participate in the study with two classes they teach. One of the classes was randomly assigned to the control group and the other class was assigned to the treatment group prior to initiating the study. To mitigate the results of teachers selecting their higher performing classes to complete the Places We Live curriculum, we decided that the study would be strengthened classes were randomly assigned to the treatment group. Ten of the twenty teachers were randomly selected to teach three lessons from the *Places We Live* curriculum and use their other class as the control group, however only five of the teachers had complete data sets that were included in the study. Ten of the twenty teachers were randomly selected to teach 6 of the lessons from the *Places We Live* curriculum, with their other classes serving as the control group. Only eight of the ten teachers provided complete data sets that were included in the study. In sum, there were three groups of students: (1) the control group, (2) the three lesson treatment group and (3) the six lesson treatment group. The number of students in each group is shown in Table 1.

Instruments

The data collection for this study was collected utilizing survey methodology. Pretest and posttest questionnaires were given to students in the control and treatment groups. In addition, the teachers completed a data log for each lesson they taught the treatment group and provided information about both the control and treatment groups.

The pretest questionnaires consisted of 50 questions. Three questions measured basic demographic information: participation in the curriculum, gender, and grade level. The remaining questions measured self-assessed content knowledge, researcher assessed content

knowledge and students' attitudes toward the places they live. The following sections provide a description of each subsection of the questionnaire.

Self-assessed knowledge.

The twelve questions designed to measure self-assessed knowledge are stylistically similar in that each is a Likert-type question with seven answer choices. The answer choices were scored along a continuum from Strongly Agree (7) to Strongly Disagree (1), and I Don't Know was coded as zero (0). The total score for this section ranges from 84 to 0, with 84 being the highest score demonstrating the greatest self-assessed knowledge of the environmental issues affecting the places we live.

Content knowledge.

The twenty-two content knowledge questions each have favorable answers that indicate a superior level of understanding about the environmental issues affecting the places we live. This section is scored as a multiple choice content knowledge assessment with distracters being viable options, but do not demonstrate the degree of understanding the most favorable answer choice represents. Thus, of the five possible answers, one is correct and three are incorrect. The incorrect answers were coded as zero (0) and the correct answer was coded as one (1). The response "I Don't Know" was coded as zero. The total score for the content knowledge section ranges from twenty-two (22) indicating superior knowledge to zero (0) indicating very little content knowledge. In addition to the total score, the mean and standard deviation for each question was determined.

Attitudes.

Twelve questions were designed to measure students' attitude toward the places they live. The answer choices were scored along a continuum from Strongly Agree (7) to Strongly

Disagree (1), and I Don't Know was coded as zero (0). The total score for this section ranges from 84 to 0, with 84 being the highest score demonstrating the greatest self-assessed knowledge of the environmental issues affecting the places we live. Along with the total score the mean and standard deviation for each question was calculated.

Instrument Reliability and Validity

The researcher-developed instrument used in this study to measure students' self-assessed knowledge, content knowledge and attitudes has not been used in prior research. To that end, the reliability and validity of the instrument were determined prior to the study. A pilot study was conducted with 86 students who were not involved in the current research study.

Reliability.

The reliability of an instrument is a measure of the amount of measurement error present in the scores yielded, where measurement error is the difference between an individual's true score on a test and the scores that are actually obtained on it over a variety of conditions (Gall, Gall & Borg, 2003). To determine internal consistency of the self-assessed knowledge and attitude sections of the instrument a split-half correlation coefficient was determined. Chronbach's coefficient alpha was determined for each section of the instrument because it can be used when items are not scored dichotomously (Gall, Gall & Borg, 2003). Since the self-assessed knowledge section and the attitude section utilize Likert-type responses that are weighted, the Chronbach's alpha measure is ideal for these sections. For the self-assessed content knowledge section Chronbach's alpha was found to be .80 and for the attitude section Chronbach's alpha was .73.

The content knowledge section of the instrument does contain correct and incorrect responses. To determine the test's internal consistency the method of rational equivalence will

be utilized. The Spearman-Brown prophecy formula was calculated for the content knowledge questions to determine reliability due to the short length of the knowledge section. The Spearman-Brown coefficient was found to be .75.

Validity.

To determine the validity of the instrument a panel of environmental educators, environmental consultants, city planners and teachers of grades 7-12 were given the instrument and the *Places We Live* curriculum. Each expert compared each of the self-assessed knowledge, content knowledge and attitude questions of the instrument to the *Places We Live* curriculum. With feedback from the experts, the instrument was revised and agreed to be valid based on expert analysis.

Data analysis

Data collected from the control groups and both treatment groups (3 lesson treatment group and 6 lesson treatment group) was entered into SPSS. Both pretest and posttest data was entered into SPSS and coded based on the control or treatment group each student was assigned to by the researchers. Analysis consisted of several steps. First, descriptive statistics were computed for each question from the pretest and posttest. Second, an ANCOVA was performed to determine if the change in treatment scores was significantly different than the change in the control scores, with the covariate being the pretest scores. Third, the pretest scores were compared to the posttest scores for each group and for each of the 3 sections of the instrument to determine the extent to which the scores changed. The following sections describe each step in greater detail.

Descriptive statistics.

Each question from each of the 3 sections was coded as described above. The mean score was computed for each question. A total score for each section was then computed for each of the three groups: control group, the 3 lesson treatment group, and the 6 lesson treatment group. In addition to the mean score, the standard deviation was also computed.

Effect of treatment.

To determine the effect of the treatment (both 3 lesson and 6 lesson treatment groups) an analysis of covariance (ANCOVA) was conducted. The preferred statistical method is to compare the posttest mean of the experimental group with the posttest mean of the control group with the pretest scores as the covariate (Gall, Gall & Borg, 2003). By doing so, differences in the initial pretest scores between the control group and the treatment group can be adjusted. Based upon the results of the ANCOVA, specific *t*-tests were conducted.

Pretest-posttest gains.

In an attempt to determine pretest-posttest gains within each group a *t*-test was computed for the control group and each treatment group. While these values do not speak to the significance of the treatment, they do provide an indication of the gain present within each group. This analysis enables us to speculate on the expected gain for those teachers who may choose to implement the curriculum in its entirety or to implement some lessons from the curriculum.

Results

Pre- and posttest comparisons within groups

The mean for each of the three sections of the instrument were calculated and a t-test was conducted to ascertain if there was a statistically significant gain between the pre- and posttest

applications (Table 2). The results indicate several significant gains ($p<.05$). Both the 3 and 6 lesson treatment groups showed significant gains on the student assessed content knowledge section ($p=.00$ in both cases). Only the 6 lesson treatment group showed a significant increase in mean score on the researcher assessed content knowledge section ($p=.04$) and the attitude section ($p=.00$) of the instrument. On all three sections the general trend was an increase in gains from pretest to posttest with increased exposure to lessons. For example the measurement of attitude indicates a slight decrease between pretest and posttest scores among the control group (-.10), a slight increase in scores among the 3 lesson treatment group (+1.74) and significant increase in scores among the 6 lesson treatment group (+7.46).

Table 2
Comparison of pre- and posttest mean class scores of dependent variables for 3 lesson experimental group (n=93), 6 lesson experimental group (n=171) and control group (n=200) participants.

		M		*t* Test	
Dependent variable	Group	Pretest	Posttest	*value*	*p*
Student assessed	Control	32.03	34.70	-1.67	.10
content knowledge	3 lesson	27.96	38.60	-4.19	.00
	6 lesson	35.66	47.21	-7.03	.00
Researcher assessed	Control	9.20	9.14	.19	.85
content knowledge	3 lesson	10.75	12.43	-1.09	.28
	6 lesson	9.85	10.68	-2.08	.04
Attitude	Control	41.50	41.40	.05	.96
	3 lesson	41.28	43.02	.56	.58
	6 lesson	42.82	50.28	-4.47	.00

Pre-test and posttest comparisons across groups

Analysis of covariance results.

An analysis of covariance (ANCOVA) was conducted wherein the mean scores of the control group, 3 lesson treatment group and 6 lesson treatment group were analyzed (Table 3). The pretest scores were used as a covariate to provide an adjusted mean posttest score to account for differences in the initial abilities of the students as shown by the variance in pretest scores.

The results indicated significant differences across the three groups (control, 3 lesson treatment and 6 lesson treatment) on all three measures. There was a significant difference (F=30.79, p<.05) between the three groups with respect to student assessed content knowledge. With respect to researcher assessed content knowledge there was also a significant difference (F=13.54, p<.05) among the three groups. Finally, a significant difference (F=23.87, p<.05) was established among the three groups on the attitude measurement. The results of the ANCOVA were promising but they do not indicate between which groups there were significant differences. Thus, independent samples t-tests were conducted on the posttest mean scores.

Table 3
Analysis of covariance for adjusted posttest mean scores on test measures between 6 lesson experimental group (m=171), 3 lesson experimental group (n=93) and control group (m=200).

Measure	6 lesson experimental group	3 lesson experimental group	control group	*F*
Student assessed content knowledge				
Pre M	35.66	27.96	32.03	
Post M	47.21	38.60	34.07	
Adj M	46.54	40.57	34.96	30.79*
Researcher assessed content knowledge				
Pre M	9.85	10.75	9.20	
Post M	10.68	12.43	9.14	
Adj M	10.66	13.02	9.20	13.54*
Attitude				
Pre M	42.82	41.28	41.50	
Post M	50.28	43.02	41.40	
Adj M	49.97	43.42	42.72	23.87*

*p<.05

Independent samples t-test results.

With the results of the ANCOVA to guide us, we further explored the interaction between the treatment and control groups by computing independent samples *t*-tests. The *t*-tests permitted the comparison of the treatment groups to the control groups directly for each of the 3

measures. In the first series of tests we explored the difference between the 3 lesson treatment group and the control group (Table 4).

Table 4
Independent samples *t*-test comparison of posttest mean scores on test measures between 3 lesson experimental group (n=93) and control group (n=200).

Measure	*mean difference*	*value*	*p*
Student assessed content knowledge	3.90	-1.64	.10
Researcher assessed content knowledge	3.29	-5.37	.00
Attitude	1.61	-.64	.52

We hypothesized that there would higher scores among the 3 lesson group compared to the control group. While there was an increase among each of the three measures, only the researcher assessed content knowledge measure yielded a significant difference (p=.00) between the mean scores of the control group compared to the mean scores of the 3 lesson treatment group. The a priori established significance was set at .05. For that reason, the students assessed content knowledge increase cannot be considered significant even though we can be 90% certain that the increased scores among the 3 lesson treatment group were a result of exposure to the Places We Live curriculum.

Again, we hypothesized that the greatest increases on all three measures should take place between the 6 lesson treatment group and the control group. The results of the independent samples *t*-tests indicated significant differences between the 6 lesson treatment group and control group on all three measures. As indicated in Table 5, the mean differences between the groups were significant at the p=.00 level for the student assessed content knowledge, researcher assessed content knowledge, and attitude measures.

Table 5
Independent samples *t*-test comparison of posttest mean scores on test measures between 6 lesson experimental group (n=171) and control group (n=200).

Measure	*mean difference*	*value*	*p*
Student assessed content knowledge	12.51	-6.88	.00
Researcher assessed content knowledge	1.54	-3.98	.00
Attitude	8.88	-4.72	.00

At the outset of this quasi-experimental research, we hypothesized that greater exposure to the Places We Live curriculum, should result in greater gains on the three measures. The adjusted means shown in Table 3 indicate a general trend of increased scores with the lowest scores among the control group and the highest scores among the 6 lesson treatment group. The exception to this trend is the researcher assessed content knowledge scores were actually highest among the 3 lesson treatment group. This may be, in part, due to the lower number of participants in the 3 lesson treatment group, which may have been high achieving students. This would not influence the other measures which are self-reports of their content knowledge and attitude toward the place they live.

Discussion

One difference between this evaluative study and other evaluative studies conducted on Project Learning Tree curricula is that, in the present study, teacher participants were assigned activities to cover with their students. Previous studies had teachers choose which activities to present (Gomez-Schmidt & Zint, 2005). We feel that our results are more powerful given that each participant within a treatment group administered the same portion of the curriculum.

The current study sought to resolve three questions:

- Does the Places We Live curriculum improve students' attitudes toward the environment and their place in it?

- Does the Places We Live curriculum increase students' content knowledge about environmental issues and their community?
- Does the Places We Live Curriculum improve students' perceptions of the amount of knowledge they maintain with respect to the environmental issues and attributes within the places they live?

The results suggest the answer to each of these questions is yes, but also provide more detailed insight into the effects the curriculum had on the students.

Student Assessed Content Knowledge

The pretest-posttest comparison of student assessed content knowledge did not change significantly among the control group. However, there was a significant gain among the three lesson treatment group and the six lesson treatment group, although the gain was slightly greater among the six lesson treatment group suggesting that exposure to the curriculum increased students' self-reported content knowledge. Thus, participation in the curriculum provided students with a sense that they could contribute to, and help solve, environmental issues within their communities. Additionally, a comparison of posttest scores indicates that the only significant gains produced were between the control and six lesson treatment groups, suggesting that the curriculum is most beneficial when not parceled out into separate lessons. This is an important finding for teachers and teacher educators, given the range and depth of content that teachers are required to cover over the course of an academic year. This finding clearly indicates the importance of utilizing curricular materials in their entirety for maximum gains.

Researcher Assessed Content Knowledge

The content knowledge assessed by the researchers indicates a similar pattern to the students' self-reported content knowledge. As the amount of exposure to the *Places We Live*

curriculum increased, so too, did the researcher assessed content knowledge. A comparison of pretest to posttest scores indicated that the only significant gains were among the six lesson treatment group. Thus, the lessons the control group were exposed to, i.e. the teacher's normal curricular materials, did not produce an increase in content knowledge regarding the environmental issues affecting the places the students live. A comparison of the posttest scores did indicate a significant increase among both the three and six lesson treatment groups. This finding indicates that much of the tested information would not normally be acquired by the students in the classes partaking in this study. These results also indicate that teaching portions of a curriculum can still have beneficial effects for students, although the more of the module covered, the more benefits that were reaped. While we had hoped to see gains among the 3 lesson treatment group in self assessed knowledge and attitude, we are quite pleased to see that even exposure to a short segment of the module did produce significant gains in researcher assessed content knowledge. However, if educators seek to teach students who can make informed decisions about the environmental issues affecting their community, the entire curriculum is likely to produce better results that selecting individual activities from the curriculum.

Attitudes

There are few studies that have been able to demonstrate a significant change in environmental attitude or change in behavior toward the environment (Bamburg & Moser, 2007; Barr, 2007; Heimlich & Ardoin, 2008). Such influences have been difficult to demonstrate. Although it is not possible for us to longitudinally track changes in environmental attitude among the students involved in this study or to determine whether their exposure to the module will bring about a change in their behavior toward the environment, the results shown here are

promising, and reiterate the concept that the more exposure students have to environmental education and environmental issues, the more stewardship they will feel towards the environment.

Whereas the control group made almost no gains during the time of the study, the six lesson treatment group made significant gains in their attitudes about the environment and their place in it. Students were clearly able to identify the salient aspects of their environment and the challenges to maintaining a community given the external pressures often placed on communities as they grow and evolve. The students who completed six lessons of the curriculum had much more positive attitudes regarding their ability to identify and help solve environmental issues in their communities. There was not a significant difference between the control and three lesson posttest scores, but there was a significant difference between the control group and the six lesson treatment group with respect to their attitudes about their communities and their abilities to solve community related environmental issues. Clearly the completion of all six lessons produced the most significant increase in the students' attitudes toward environmental issues, resulting in a group of students who are more confident in their ability to help solve complex socioscientific issues.

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