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# Elementary School Education in Rainforest Conservation and Reforestation in Mindanao, Philippines

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**Abstract**

A series of four interactive interdisciplinary (but based on science) books, for grades two through five, were created to provide educational materials on tropical rainforests for elementary schools in the Philippines. The books were produced in conjunction with Philippine and American teachers, administrators, and science education consultants. They were then used and assessed for a year in actual classrooms in a variety of six Philippine schools in Mindanao. Comparative tests, before and after using the materials, were given to both teachers and students in participating schools. We observed highly significant measurable learning and improvements in understanding about rainforests. There was much variability in outcomes among the different schools. A highly significant general trend among students, however, was for greater improvement (gain) for students who had lower pretest scores. That trend for individual students extended to the schools, which reduced the discrepancies between public rural mountain schools and schools in urban or city settings, including a private city school.

Keywords: elementary education, environmental education, rainforest conservation, reforestation

## Introduction

The problem of rainforest destruction and associated biodiversity loss in the Philippines is widespread and widely recognized (Brooks et al., 2002; Myers et al., 2000; Ong et al., 2002). There currently may be only 7 percent of the original Philippine forest remaining (Ong et al., 2002). We believe that a major contributing factor in the problem is a lack of understanding and conservation attitudes among the general citizenry. Education focused on the rainforest could potentially improve both knowledge and attitudes. As succinctly stated by Dioum (1968) of Dakar, Senegal, Africa: "In the end we will only conserve what we love. We will love only what we understand. We will understand only what we are taught."

Much work has been done around the world on conservation needs, education, and educational assessment but there have been few attempts to integrate those topics at the elementary school level (Vaughan et al., 1999). Elementary level education is important because it lays the foundation for future learning, understanding and citizenship, including decisions and actions involving individuals themselves and their communities, and because many rural schools do not offer education beyond the elementary level.

We hypothesized that incorporation of conservation subjects and prepared resource materials into elementary curricula would produce measurable learning. We, thus, produced a series of science-based, novel, interactive, interdisciplinary thematic books, titled *The Tropical Rainforest and the People* (TRP) for use in elementary schools in the Philippines.

We tested the books in six schools of various types (city, urban, rural mountain, and public, private) in Mindanao and assessed whether learning occurred. Our study included pretest assessment questions, teacher training, use of the materials in the classrooms, and follow-up posttest assessments plus teacher debriefings. Comparisons were made of teacher and student knowledge before and after using the books. This paper presents the results of that study.

### Background: "Classrooms That Make a Difference" and preparation of the *Tropical Rainforest and the People* book series

The foundation for this project was developed and established by one of us, Joyce Grier, in association with helping Jim's work with the Philippine and other eagles (Buesser et al., 2003; Grier, 1973, 1982). She and several teachers in Fargo, North Dakota, U.S.A., and

two schools in the Philippines initially developed a sister-classroom project ("Classrooms that Make a Difference," or CMD). This project connected Fargo middle school classes with partner classes in the Philippines, whereby the Fargo students learned about their partners and tropical rainforests, and helped generate funds to support tree planting by the Philippine students.

The CMD project ran for seven years, from 1992-1999. It was highly successful and benefited all involved. However, it became obvious that the scale was too small. Not enough students were involved to significantly impact the problems on the larger real scale. Instead, there is a critical need to reach students throughout the Philippines, not just those in a few classes in Mindanao. A large-scale approach requires associated books and materials. But at the time (1999-2000), we were unable to find Philippine environmental educational materials for the elementary school level. Furthermore, traditional approaches to science education focusing on scientific topics and information without a larger context have often been ineffective.

In response, Joyce worked with coauthors and artist, Teresa and Harvey Ishiki to prepare a series of elementary school books involving new strategies. The key, we believe, is not just providing students with information, but rather tying the important information to engaging, interactive activities. Students learn and remember by doing things, having fun, and developing associated feelings and emotions involving the subject.

Research on what students do to learn materials from their classrooms provided the framework for the TRP book series. Academic work in elementary classrooms has been well studied. Doyle (1983) referred to "academic tasks" as a way to provide a framework to describe the relationships between the classroom, the curriculum, and the opportunities-for-learning. The tasks that teachers develop for their students are cues for what students should pay attention to as they learn the material. Findings from a number of disciplines reveal novel tasks lead to greater transfer of knowledge and are more likely to result in meaningful learning (Herbst, 2003). The TRP books include novel academic tasks and curricula. The books were developed to address local, national, and international rainforest conservation issues in an integrated fashion with science, mathematics, grammar, writing, social studies, geography, and art intertwined throughout each of the four books.

Accompanying lesson guides were also produced for teachers using the books. Several US and Philippine elementary grade teachers helped prepare the lesson guides.

The making of the book series involved input and participation from Philippine and US teachers, administrators, and science education advisers. Jim, as a university professor in biology, served as the science editor. Writing, illustrating, review by elementary school teachers, administrators, and science education advisers, preparation of teacher's lesson guides, editing, revision, and production of the series took five years. The development and production of the books as well as this assessment study were funded privately.

## Materials and Methods

We selected six schools on the island of Mindanao to test and assess the books. One school was a private city school, one was public urban, and the remaining four were public rural mountain schools. All four of the mountain schools were in communities near rainforest with Philippine eagle sightings or known nests.

Two sets (Pretest and Posttest) of assessment tests, with 20 questions per test, were formulated for each of the four books. Questions were comprised of a random sample of review questions directly from the books plus similar, but differently worded, new questions. A core set of questions for standardizing and calibrating the results were included in both Pretest and Posttest. The remaining questions were different between the Pretests and Posttests but designed to be of comparable content and difficulty for both tests

Participating teachers were brought to the Philippine Eagle Foundation (PEF) in Davao City for two-day training workshops led by the site Project Coordinator. The PEF has years of experience and practice working with teachers, classes, and hosting training programs. The teachers were given the Pretest assessment to assess prior understanding of the subjects. They were then trained on how to use the materials in their classes, including the prepared lesson guides that accompany the books.

Students in participating classes were given the appropriate Pretest. Then the teachers used the books in their classes. At the end of the school year, both the teachers and students were given the Posttest. Finally, a second two-day teacher workshop for debriefing and feedback on the use of the materials was held at PEF's Education Center.

The Pretests and Posttests were compiled and scored by Joyce Grier, with the results being entered into spreadsheets (MS Excel) for statistical computer analyses (using SYSTAT 8.0). Analyses

involved actual test scores (0-20) and the differences (gain) between pretest and posttest (which could be negative if posttest was lower). Results were analyzed only for individuals who took both pretest and posttest (a few teachers and many students were present only for one or the other).

A confounding aspect for analyzing gains involves the fact that a few participants (1) had very high pretest scores to begin with, thus, they were limited in how much gain they could demonstrate and (2) some participants achieved maximum scores on the posttest. That imposed an upper limit, or ceiling, on gain, which became more restricting with higher pretest scores.

There are three potential solutions to the "gain limit" problem, two that twist and skew the results unacceptably and one that, in our opinion, is acceptable. The two possible solutions that don't work are (1) converting actual gain to a proportion of possible gain and (2) incrementally shifting the results for each sequential pretest score up by one to, in effect, raise the slope of the ceiling to make it horizontal. In both cases, it makes the results unfair and converts them in a way that defies easy interpretation, in the first case by warping the scale (even though the technique is occasionally used in educational statistics) and in the second case by giving those with higher pretest scores a potential advantage that they might not deserve. We noticed in the case of the students (but not the teachers) that many of those with high pretest scores did more poorly on their posttests (i.e., showed negative gain). Some of those with high pretest scores might simply have been guessing and were lucky on their pretests without really knowing the subject material.

Our solution to the "gain limit" problem was as follows: we omitted two categories of scores: (1) those with pretest scores above 15 (which constituted only a small number of cases and which were outside the range of the majority of the distribution of students anyway, as can be seen by inspecting the curve in Figure 1) and (2) all cases with posttest maximum scores, i.e., 20 (and, thus, all remaining cases still had the potential of being able to show more gain). The students with maximum scores, incidentally, were spread fairly uniformly over the entire range of pretest scores. Thus, omitting those with maximum scores should be unbiased. As a double check on possible bias, we analyzed the data both with and without the maximum-posttest cases included and got identical results. As a result we could have used either analysis, but we chose to retain the one without maximum-posttest cases as a matter of philosophical principle.

Statistical analyses and presentation of outcomes consisted of descriptive statistics and familiar inferential tests using null hypothesis significance testing (via t-test, paired t-test, correlation, regression, and analysis of variance). The box plots used in the figures depict a line for the median (which is generally at or nearly the same as the mean), boxes for the central 50 percent of the values, lines that extend to 90 percent, and asterisks for outliers beyond 90 percent of the curve. We also used accompanying bar graphs with the "normal" curve superimposed over the bars (Figure 1).

Names of individual schools, teachers, and students have been kept confidential. Only the statistical outcomes are presented.

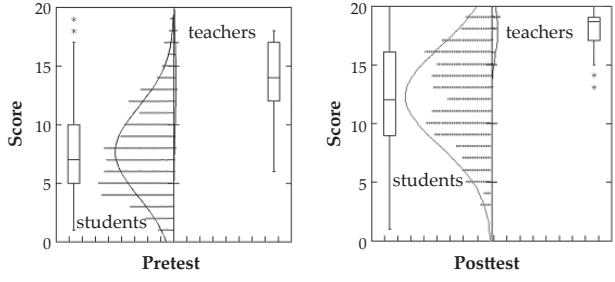


**Figure 1.** Distributions of pretest versus posttest scores for students and teachers, as shown both by bar graphs, superimposed normal distribution and box plots. The box plots depict the median with the central line, the central 50 percent of the observed values with the box, 90 percent of the values with the extended lines, and outliers with asterisks. See text for the various possible comparisons and associated statistics

## Results and Discussion

There were four grades, one class per grade, with one teacher each for each of the six participating schools, for a total of 24 classes and 24 teachers. The total number of students involved was 830 (mean = 34.6 per class). However, three teachers and 229 students took only one of the assessment tests, not both. Thus, we ended up with 21 teachers and 601 students, or 622 total individuals, whose outcomes could be analyzed.

A comparison of the paired pretest to posttest scores for all 622 individuals, teachers and students, who took both the tests, demonstrated overall highly significant learning ( mean pretest score = 7.88, mean posttest = 12.45, paired-t = 28.59, n = 622, df = 621, $P < 0.001$). A few participants had the same or lower scores on the posttest compared to the pretest for the same individual, but the

vast majority showed increases and many got the maximum score of 20 on the posttest. The mean gain in score for all 622 participants was 4.57 (with many individuals getting much higher).

The outcomes for students are shown separately from those of the teachers in Figure 1. The results are depicted both in bar graph/normal distributions and box plots.

Several comparisons of these results are possible. Both the students and teachers did significantly better on the posttest than on the pretest (students paired-t = 27.93, n = 601, df = 600, $P < 0.001$; teachers paired-t = 6.81, n = 21, df = 20 $P < 0.001$). We would expect teachers to do better than students, but, partially as a check of our methods and results, we verified that, indeed, that was the case (student versus teacher, pretest t = 6.99, df = 620, $P < 0.001$; posttest t = 6.17, df = 620, $P < 0.001$).

A comparison of students with teachers for the gain in score from pretest to posttest, however, yielded no significant difference (t = 0.33, df = 620, P = 0.75). It appeared that the teachers learned about the same amount and no more, in terms of gain, than students. However, the teachers started with much higher pretest scores to begin with and were, thus, building on a higher foundation of understanding.

Because teachers, who had higher pretest scores, showed similar gains to students, who had lower pretest scores, we can ask a similar question regarding just the students. That is, did students with higher pretest scores gain the same as students with lower pretest scores?

The results following our adjustment to avoid the "gain limit" problem (see Materials and Methods) are shown in Figure 2. Unlike the student versus teacher comparison, there were differences among students depending on their pretest scores.

Several of the comparisons show the same or similar gains, across the various pretest categories, as was seen for teachers versus students. In particular, the gains are virtually identical for pretest scores of 7, 8, 11, and 12 in terms of medians and the 50 percent boxes. They are also similar for pretest scores of 2, 3, 4, and 9.

There was a lot of variation in gain, as might be expected in measurements of this kind. The overall trend, however, clearly shows that students with lower pretest scores gained (learned) more than those with higher pretest scores. The trend was highly significant, whether analyzed by correlation (Pearson correlation r = -0.38, n = 566, $P < 0.001$) or regression analysis (gain = 7.73 - 0.421pretest; F = 94.25; df = 1, 564; $P < 0.001$).

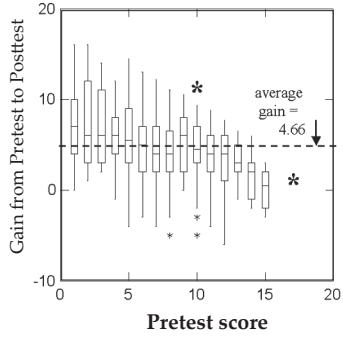


**Figure 2.** Gains in student learning broken down by different pretest scores. Students with lower pretest scores (unlike the comparison between students and teachers, see text) tended to show higher gains in learning than those with higher pretest scores. The trend was highly significant ($P < 0.001$, via either correlation or regression). *Cases with pretest scores above 15 and maximum posttest scores of 20 were excluded from the analysis to avoid the maximum limit problem

We next considered differences in gain among the different schools. We discovered that the trend shown by students extended to the level of the school. This is perhaps illustrated most easily and interestingly by showing the school results for pretests side by side with the posttests, Figure 3. Results are highly significant among schools in all comparisons (by ANOVA), for pretests ($F = 35.70$; $n = 566$; $df = 5, 560$; $P < 0.001$), posttests ($F = 36.48$; $n = 566$; $df = 5, 560$; $P < 0.001$), gain per se ($F = 25.34$; $n = 566$; $df = 5, 560$; $P < 0.001$), and gain with pretest as a covariate ($F = 29.19$; $n = 566$; $df = 5, 560$; $P < 0.001$).

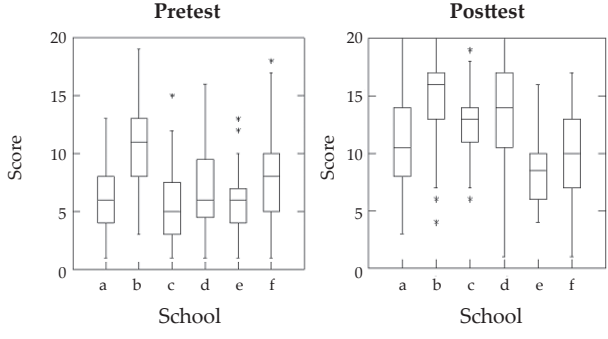


**Figure 3.** Differences in learning (gain) among students with different pretest scores (Figure 2) extended to the level of the school, as can be seen in a close inspection of this figure. The use of the workbooks brought the four rural mountain schools (a, c, d, and e) with lower pretest scores up to or above the two schools with the highest pretest assessments (b = private city school, f = public urban school). All schools demonstrated significant gain from pretest to posttest assessment

The school with the highest pretest score was the private city school (school b in Figure 3). The school with the next highest pretest score was the public urban school (f in Figure 3). The four public rural mountain schools had the lowest pretest scores and were similar to each other. On the posttest, however, the private city school still had the highest score, but some of the others were catching up. The four mountain schools came up considerably, with three of them exceeding the urban school on the posttest. Also note that some of the students in three of the schools, including two of the mountain schools, reached maximum scores of 20 on the posttests.

Thus, the use of the books brought those schools with lower pretest scores up to or above the two schools with the highest pretest scores. In other words, these books helped level the playing field between the rural mountain schools and the private or public city and urban schools. Most importantly, however, significant gains were shown in ALL of the schools, regardless of their demographics otherwise.

## Conclusions

The three major conclusions from this study were: (1) The elementary level science-based, novel, interactive, interdisciplinary thematic books accomplished their goals in a variety of schools. Measurable results were achieved, with significant learning among students in all types of schools tested. Students and teachers reported that they had fun in the process. (2) The largest gains in learning occurred among students with the lowest pretest scores. (3) The advantage in gain observed for students extended to the schools, reducing the discrepancies among different types of schools. The largest gains occurred in rural mountain schools located near rainforest with Philippine eagles present. The introduction of these resource materials and novel approaches to science and environmental education helped improve equality among schools at the primary school level.

Some might ask whether elementary environmental education, even if it works, is worthwhile in the first place. In a Costa Rican study, only 29 percent of politicians and 11 percent of parents viewed elementary students as being the key audience for environmental information, whereas 55 percent (still barely over half) of environmental educators viewed the elementary level as primary importance (Fundación Neotrópica, 1988), also see Sutherland and Ham, 1992). Ham et al. (1989) suggested that teachers are more likely than others to recognize the importance of elementary students for environmental education.

One commonly stated problem with focusing on elementary education as a tool for helping solve conservation and resource problems is that it potentially takes much time until the children grow up and for their learning to become effective. As described by Medina (1989), [we] "... do not have the luxury of waiting for today's children to grow up. Unless [adult] behaviors change now, there will be little tropical forest left to save".

We, however, believe that environmental education at the elementary level is critically important and may even have immediate effects. Needs are both short term and long term. We are not just dealing with a ningas cogon ("grass fire" or "something that has brief, intense interest but which does not last")! It is true that immediate action is called for, but it must be sustained into the distant future. And reforestation, with the planting, growth, and development of trees and entire biotic communities requires a very long time. As one old proverb puts it, "Wise is the person who plants a seedling that will provide shade for a future generation."

Even the youngest of today's students can do things with immediate results, like planting trees and influencing their parents and community elders. In a study by Vaughan et al. (1999), children learned conservation principles at school, transferred them to older family members, who in turn transferred them to other adults in the community, which greatly magnified the original effort and input. A similar study was reported by Volk and Cheak (2003).

Efforts to enlighten adults on environmental issues in the Philippines have been ongoing for 35 or more years, starting at least with the efforts of FREE (Films and Research for an Endangered Environment) and the subsequent development of several environmental NGOs, including Haribon and PEF along with international groups such as World Wildlife Fund (WWF) and Conservation International (CI). There were concerned individuals in Philippine universities, government agencies, media, as well as a few private citizens who were voicing conservation pleas even prior to the above groups. All of these have been operating mostly at the adult level. It seems logical and of utmost importance to also bring children into the picture.

We note that our study represents only a beginning step in understanding and developing environmental education and assessment at the elementary school level in the Philippines. We need more information that will, in turn, require more research, time, effort, and costs. But the results so far are clear that proper resources and classroom teaching produce measurable and meaningful results.

The results encourage us to move forward into the next phase: (a) improved teacher training in hopes of greater learning gains and (b) assessing student, teacher, parent, and community actions in sustainable conservation projects that result from the classroom learning. Ideally, further assessment and the continued development and improvement of techniques and resources will accompany the expanding presence in classrooms across the country. Future citizens and the rainforest plants and animals will thank you!

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