

A Study of the Effectiveness of the 3D Library Program

Background and Purpose

During the fall semester of 2009, SEG Research conducted a national, multi-site study of 4th grade students to evaluate the effectiveness of the 3D Library, an instructional tool enhanced by augmented reality combining written books with computer-delivered 3D animation. The 3D Library program is a supplemental educational tool that can be used in either school or home environments.

The findings indicate that students in classes using the 3D Library Program with both the books and computer-based animations made significantly greater gains in science knowledge and skills as compared to students in classes that used only the books or classes that did not use any of the 3D Library Program components.

About 3D Library

The 3D Library Program contains a full range of science and social studies content aligned to grades one through six; plans call for adding additional content areas in the future.

The 3D Library Program consists of two components: 1) a set of books, each containing age-appropriate content aligned to the book content and includes extensive illustrations and photographs where appropriate. and , 2) a computer equipped with a webcam (or dedicated device) with the 3D Library software, animations, voiceovers, and music.

To use 3D Library, the student reads the book directly in front of the computer/device where the webcam can recognize the page content. As each two-page spread is opened, the 3D Library software automatically recognizes the page and launches the aligned

animation on the computer screen along with narration and music. The animations are presented using augmented reality, which presents a visual image along with an actual image (in this case, a 3D animation with the actual book and the student reading the book).

Students can move the book from left to right, turn it and tilt it, and the image will move and change position with the book. For example, an image of an animated dinosaur can be seen from the front and side by turning the book.

The tool is designed to support educators and engage students in learning science and social studies content and can be used in both one-on-one and group settings in numerous ways, from introducing a new lesson or topic to illustrating complex subject matter to learning a body of newly introduced content.

Study Design

The study examined the effectiveness of the 3D Library Program by comparing the growth in science knowledge and skills among students using 3D Library with both the books and computer-based animations, to a comparable group of students who used only the books and a control group that used none of the 3D Library components.

In October and November of 2010, 329 students in 17 classrooms in six schools participated in a controlled study of 3D Library effectiveness. Using a quasi-experimental, pre-post design, this study compared the growth in Science knowledge, skills among three groups of students: classes using both the books for the 3D Library Program and computer-delivered augmented reality animations (Treatment Group1), classes using only the books for the 3D Library Program (Treatment Group 2), and a Control Group of students in classes that did not use either the books or computer-delivered augmented reality component.

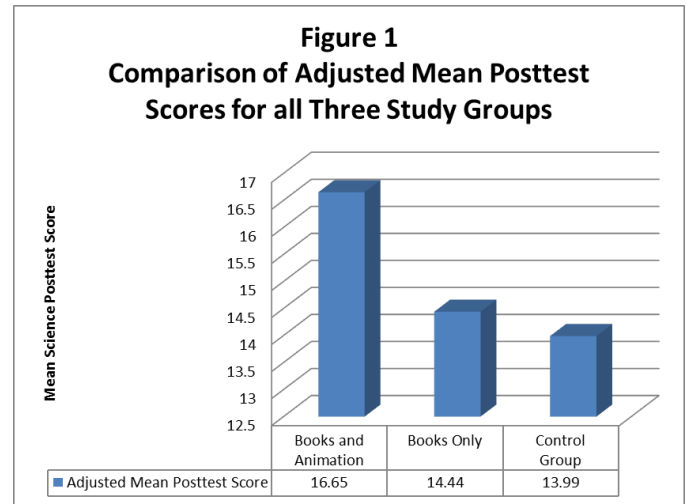
This study was conducted by SEG Measurement, supported by a grant from SK Telecom. SEG is an independent research firm, providing research services to educational publishers, technology providers, and government agencies, since 1979.

Growth in science knowledge and skills and attitudes toward science were measured by comparing scores on a 30-item pretest of science knowledge and skills at the beginning of the study and a 30-item posttest at the end of the study. The results from the pretest and posttest were compared statistically to determine the level of growth in science knowledge and skills. Students in the three study groups were comparable in ability. Any initial differences in the science knowledge and skills of students in the three study groups were statistically controlled during analysis.

Results

We compared the gains made by students in all three study groups, controlling for any initial differences in science knowledge and skills. Students who used both the 3D Library Program books and the computer-delivered augmented reality animations (Treatment Group 1) were compared to both those students who used only the books from the 3D Library Program and to the Control Group of students that did not use any of the 3D Library components. We used a statistical procedure known as analysis of covariance (ANCOVA), to provide a more accurate comparison of growth among groups. This analysis compares differences among the three groups as if they were identically matched in initial science knowledge and skills. The students in Treatment Group 1 that used both the books and computers within the 3D Library Program showed statistically greater gains in science knowledge and skills than those students in Treatment Group 2 that used only the books or the students in the Control Group who were not using any of the 3D Library Program components. Gains by the 3D Library users were statistically significant at the $p < .01$ level.

When controlling for students' initial science ability, students who used both the books and computers (Treatment Group 1) finished the study with science test scores that, on average, were 15% greater than students using only the books (Treatment Group 2) and 19% greater, on average, than students using none of the components in the 3D Library Program (Control Group). (see Figure 1).



To better understand the magnitude of growth students using both the 3D Library Program books and computers compared to book only users and the Control Group, we looked at the "effect size," a common metric that can be used to evaluate the amount of growth. We compared the average (mean) score for the 3D Library users Group to the average (mean) score for the other groups (adjusted for any initial differences in student ability).

The effect size for the comparison of students using both the 3D Library Program books and computers to students using only the books for the 3D Library Program was .47. The effect size for the comparison of students using both the 3D Library Program books and computers to Control Group students who did not use any of the 3D Library Program components was .56.

This is a large effect; for a student at the 50th percentile, an effect size of .47 reflects an increase to the 64th percentile and an effect size of .56 reflects an increase to the 71st percentile.

Conclusion

Students who used the 3D Library Program incorporating both books and computer-based animations learned significantly more than comparable groups of students who used only the books or who used none of the program components.