

An Evaluation of the Effectiveness of Graphically Enhanced Learning Materials

Executive Summary



This study was conducted by SEG Research, an independent educational research firm located in New Hope, Pennsylvania. SEG Research provides research, evaluation, and assessment services to educational publishers, educational technology providers, assessment service providers and government agencies. SEG has been meeting the research and assessment needs of organizations since 1979. This research was supported by a grant from John Wiley & Sons, Inc.

EXECUTIVE SUMMARY

Background and Purpose

During the fall semester of 2009, SEG Research conducted a national, multi-site study of students enrolled in entry-level college Psychology, Geology and Environmental Science courses.¹ The study was designed to evaluate the effectiveness of Wiley Visualizing. Wiley Visualizing includes both graphically-enhanced textbooks and digital media, and is designed to better engage students and improve student learning and retention through to course completion. Wiley Visualizing makes extensive use of visual pedagogy to enhance the student learning experience.

Students who use Wiley Visualizing perform better in their course than do students who do not use a Visualizing book. Students using Wiley Visualizing did 20-25% better on the posttest than those students using a competing textbook.

The experiment involved over 1,200 students and 17 instructors at 12 different institutions. The students were enrolled in either a Psychology, or Geology course.

DEFINITION:

Treatment Group = classes that used Wiley Visualizing
Control Group = classes that did NOT use Wiley Visualizing.

Students in the Control Group used competing texts including:

- Jordan / Grotzinger, The Essential Earth
- Tarbuck, Earth Science
- Withgott, Environmental Science
- Hockenbury, Psychology
- King Essentials, Psychology

The goal of this study was to evaluate the effectiveness of Wiley Visualizing. The study compared the growth in content knowledge and skills among students using Wiley Visualizing and a comparable group of students who did not use Wiley Visualizing. **The findings indicate that students using Wiley Visualizing made significantly greater gains in content area knowledge and skills over the course of a semester than students in classes that did not use Wiley Visualizing.**

Study Design

During the fall semester of 2009, 1,203 students enrolled in courses taught by 17 instructors at 12 different institutions from across the United States participated in a controlled study of the effectiveness of Wiley Visualizing. Classes that used Wiley Visualizing during the course of the study constituted the Treatment Group and those classes that did not use Wiley Visualizing constituted the Control Group. There were 779 students in the Treatment Group and 287 students in the Control Group. Students in the Treatment and the Control Groups were similar in ability and background.

¹Environmental Science was eliminated from the study due to small sample size and attrition.

Using a quasi-experimental², pre-post design, this study compared the growth in student content knowledge and skills of students in classes using Wiley Visualizing (Treatment Group) and a comparable group of students who did not use Wiley Visualizing (Control Group). Student growth in content knowledge and skills was measured by comparing scores from a 50-item multiple choice measure constructed based on a survey of topics commonly taught in the introductory course administered at the beginning and the end of the semester.

Students in both the Treatment Group and the Control Group took the pretest at the beginning of the semester (August/September 2009) to obtain a baseline measure of student content knowledge and skills. Students in the Treatment Group used Wiley Visualizing during the course of the semester, while those in the Control Group used Textbooks other than Wiley Visualizing. At the end of the semester (November/December 2009), students in both the Treatment Group and the Control Group were administered the posttest. The results from the pretest and posttest were analyzed to determine the level of growth in content knowledge and skills. The study controlled for any initial differences in the initial knowledge and skill levels of students in the Treatment and Control Groups using analysis of covariance (ANCOVA).

DEFINITION:

Quasi-Experimental = A study comparing two or more groups where initial differences in the groups are adjusted statistically.

Pre-post design = A statistical method where students are tested both before and after a event (such as taking a course).

“Growth in content knowledge and skills”: The students were tested to measure the effect of Wiley Visualizing on tests measuring their knowledge and skills. Taking a class improves the student test scores by 20-25%, compared to students using competing textbooks. By testing the students before the class, we can ensure that there is no difference at the start of the study in the ability among students in the treatment and control groups.

²For a copy of the design, please contact SEG Research at: SELLiot@SEGMeasurement.com

SUMMARY OF RESULTS

Pre-Post Growth for students using Wiley Visualizing

Students who were in classes that used Wiley Visualizing showed substantial growth from pretest to posttest in both Psychology and Geology. During the course of the study, Psychology students in classes using Wiley Visualizing increased their scores by nearly 6 points (5.97) or about 12%. (Mean pretest=16.40; Mean posttest score=22.37; see Figure 1). The posttest scores were significantly higher ($t=16.55$; $df=1,277$; $p<.001$). The effect size was .98.

During the course of the study, Geology students in classes using Wiley Visualizing increased their scores by about 5 points (5.27) or about 11%. (Mean pretest=17.13; Mean posttest score=22.40; see Figure 1). The posttest scores were significantly higher ($t=8.479$; $df=1,97$; $p<.001$). The effect size was .86. This indicates that students using Wiley Visualizing showed substantial growth in content knowledge and skills during the course of the semester.

While the growth achieved by students using Wiley Visualizing is an important indicator of effectiveness, a more complete way to assess growth is to compare the growth achieved by students in classes using Wiley Visualizing to students in classes that did not use Wiley Visualizing. This allows us to see the unique contribution using Wiley Visualizing made to students' growth.

Students who use Wiley Visualizing perform better in their course than do students who do not use Wiley Visualizing. Students using Wiley Visualizing did 20-25% better on the posttest than those students using a competing textbook.

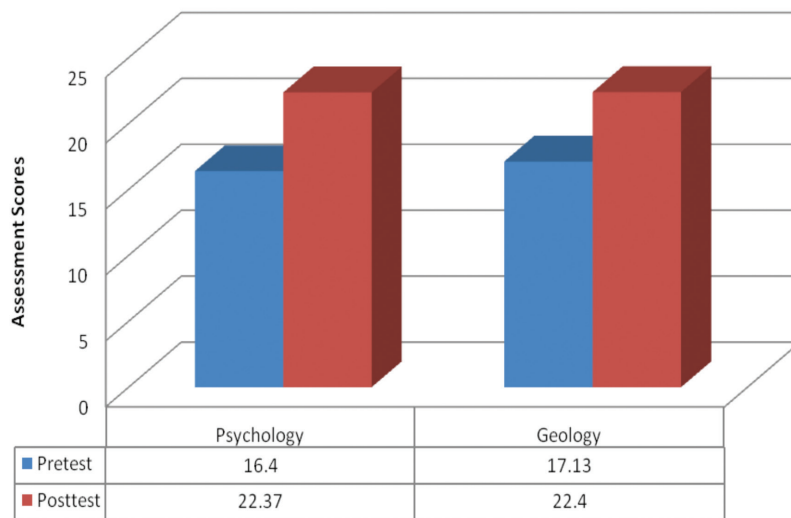
DEFINITION:

Effect size = A common metric for comparing the size of the difference in scores between two or more groups that is attributed to the variable that is tested (in this case, using Wiley Visualizing).

Overall Comparison of Treatment and Control Group Growth

The overall growth in Psychology knowledge and skills by students in classes using Wiley Visualizing (Treatment Group) was compared to the growth in content knowledge and skills of those students in classes not using Wiley Visualizing (Control Group). Analysis of Covariance (ANCOVA) was used to evaluate the difference in the posttest results (dependent variable) between Wiley Visualizing Users and those not using Wiley Visualizing (independent variable) controlling for the initial pretest results (covariate). The pretest scores were used as the covariate to place students in the Wiley Group and Control Group on the same baseline.

Figure 1
Comparison of Pretest and Posttest Scores for
Students Using Wiley Visualizing



DEFINITION:

ANCOVA = A statistical method that compares two or more groups, controlling for the different abilities of the students in the different classes.

Independent Variable = The set of variables that can be controlled in the experiment (e.g., the use of Wiley Visualizing).

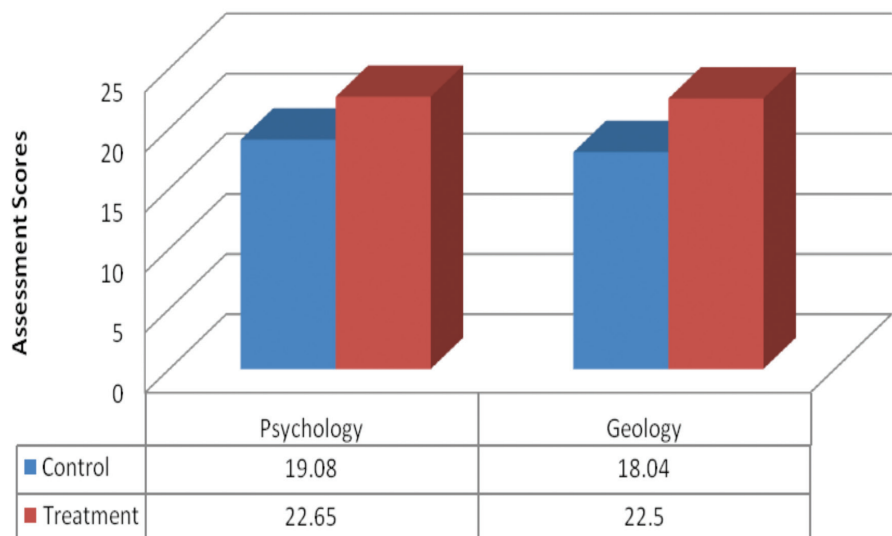
Dependent Variable = The variable that we use to measure to see if there is a treatment effect (e.g., test scores).

There were significant differences in content knowledge and skill growth between the Treatment and Control groups for both Psychology and Geology. Students using Wiley Visualizing showed much greater increases in knowledge and skills through the course, than their counterparts that did not use Wiley Visualizing.

The results show a significant difference in Psychology content knowledge and skills posttest scores between the Treatment Group and the Control Group ($df=2,411$; $F=39.00$; $p<.001$) when initial content knowledge and skills (pretest) are controlled (See Figure 2). The effect size was .58.

The results show a significant difference in Geology content knowledge and skills posttest scores between the Treatment Group and the Control Group ($df=2,157$; $F=28.17$; $p<.001$) when initial content knowledge and skills (pretest) are controlled (See Figure 2). The effect size was .73.

Figure 2
Comparison of Matched Posttest Scores for Treatment and Control Group Students



CONCLUSION

Students who used Wiley Visualizing achieved significantly greater gains in knowledge and skills than students who did not use Wiley Visualizing. Substantial differences were found for Psychology and Geology.

Wiley Visualizing users showed significant gains in content knowledge and skills from pretest to posttest (Psychology=12%; Geology=11%). More importantly, students using Wiley Visualizing did significantly better than their peers who did not use Wiley Visualizing. Psychology students scored about 4 points (8%) higher than their peers on the content knowledge and skills assessment, an effect size of .58. Geology students scored more than 4 points (9%) higher than their peers on the content knowledge and skills assessment, an effect size of .73.

These effect sizes (.58, .73) are substantial, indicating that the students who used Wiley Visualizing performed better than those students who did not use Wiley Visualizing. One way to interpret the magnitude of the effect size is to consider the potential percentile gains that could be achieved by using Wiley Visualizing. For a student at the 50th percentile, use of Wiley Visualizing could increase the student's score in Psychology to the 72nd percentile or in Geology to the 77th percentile.

These findings are particularly significant for two reasons: First, the study was conducted for only a single semester, representing fewer than 15 weeks of instruction. Second, there are many influences on student achievement; that textbook choice accounted for such a large effect on student growth in content knowledge and skill in this context, is particularly noteworthy.

Students who used Wiley Visualizing achieved significantly greater gains in knowledge and skills.

The impact of using Wiley Visualizing is significant in how students retain information in Geology and Psychology. Gains are seen in both absolute terms (i.e., the improvement from pretest to posttest) and relative terms (i.e., the advantage of using Wiley Visualizing versus not using it).

ABOUT SEG

This study was conducted by SEG Research, an independent educational research firm located in New Hope, Pennsylvania. SEG's mission is to make a measurable difference in education by providing high-quality research, evaluation and assessment services. SEG Research provides services in K-12, higher education, and post baccalaureate education and to higher education institutions, government agencies, educational publishers, and educational technology providers.

SEG is a recognized leader in research and assessment and has been meeting the needs of organizations since 1979. SEG has conducted numerous efficacy studies in areas ranging from English Language Learners to Science for both text- and, technology-based solutions designed to help students at all levels learn.

ABOUT DR. SCOTT ELLIOT, PRINCIPAL INVESTIGATOR

Dr. Scott Elliot served as the Principal Investigator for this research study. He has served as President of SEG Research for the past five years and previously served in senior roles for several research and assessment organizations. Dr. Elliot has directed numerous higher education assessment and evaluation programs including teacher evaluation and assessment programs used in 40 states and the Texas Academic Skills Program (TASP).

Dr. Elliot has been conducting educational research and developing educational assessments for more than 30 years and is a recognized expert. Dr. Elliot received his Masters Degree in instructional communication from West Virginia University and he received his Doctorate in educational policy, research, and assessment from the University of Massachusetts, Amherst. Dr. Elliot is a frequent presenter at educational conferences and has more than 75 scholarly publications and presentations to his credit.

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and SEG Research**