A Study on the Effects of Pearson's *Interactive Science 2011* Program

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Executive Summary

Increasing advances in technology and science have transformed the 21st Century global economy. In order to strengthen our nation's global economic competitiveness it is imperative that youth in today's world be provided with a strong foundation in science. They must learn to think critically; analyze complex situations and employ higher order thinking skills so that they'll be competitive in a global economy. Unfortunately, we are falling behind other countries in preparing our students to succeed in science. According to the National Assessment of Education Progress report (NAEP, 2009), only 30% of 8th grade students performed at or above proficiency in science.

In order to more fully prepare students' with the skills they need to become successful in higher level science courses, as well as their futures, Pearson has developed a new middle grades science program – Pearson Interactive Science (2011). Based on Understanding by Design, this core middle school science curriculum incorporates prior research on effective science instruction and seeks to improve upon how science is being taught in classrooms by: 1) embedding inquiry-based teaching strategies into science instruction to promote higher-order thinking skills and student engagement; 2) designing a science curriculum that addresses the latest state and national science standards; and 3) promoting real-world connections so that students have ample opportunity to apply what they learn.

It is important that programs such as Pearson Interactive Science be looked at carefully to determine the extent to which they help students attain important science skills. Planning, Research, and Evaluation Services (PRES) Associates, Inc. conducted a one year study designed to examine the effectiveness of the 2011 Pearson Interactive Science program in helping middle school students improve their science skills and understanding. This national randomized control trial (RCT), which commenced in the Fall of 2010, was conducted in the 6th-8th grades during the 2010-2011 school year. This report presents the summative findings from the study.

A total of 9 geographically dispersed schools participated in the study. The final sample consisted of 1362 students (634 control; 728 treatment). Twenty-three teachers participated in the RCT. Teachers or classes were randomly assigned to treatment (n=19) and control conditions (n=16).

Major findings, organized by the key evaluation questions, include:

Does science ability improve as a result of participation in the Pearson Interactive Science program?

Results showed significant growth over the course of the school year as measured by the national, standardized TerraNova science test, and a developed science assessment aligned to the content covered during the school year and national standards. When tests for each content area in the TerraNova were examined separately, Pearson Interactive Science students' showed significant improvement in Earth Science, Life Science, and Scientific Inquiry performance.

Learning gains experienced by Pearson Interactive Science students can also be seen in the growth of percentile ranks on the norm-referenced TerraNova Science test. It is a general rule of thumb that if a student makes a year's growth for a year of

instruction, then the percentile rank will remain the same. Over the course of the school year, the percentile ranking of Pearson Interactive Science students grew by 3.5% (57th to 60.5th percentile). The fact that the percentile rankings of students using Pearson Interactive Science increased during one school year suggests that growth in student learning occurred at a greater rate than would normally be expected relative to a national sample.

Do changes in science performance among Pearson Interactive Science students vary by different types of students and levels of implementation?

All subpopulations of students using Pearson Interactive Science showed significant learning gains in science on either one or both of the outcome assessments. That is, the Pearson Interactive Science program worked just as well with 6th, 7th, and 8th graders, females and males, White and non-White students, special education and non-special education students, English Language Learners and non-ELLs, students of varying science ability levels, and students receiving free/reduced lunch and those not receiving such assistance.

Analysis by implementation showed that Pearson Interactive Science students demonstrated significant learning gains, regardless of their teacher's level of implementation of the program.

Does using Pearson Interactive Science result in increased student achievement as compared to other types of science programs?

Results indicate that students using Pearson Interactive Science demonstrated significantly greater improvement in science as compared to students using other science programs. Specifically, Pearson Interactive Science students outperformed students using other science programs on the Developed Science test – a test aligned to the content taught in control and treatment classes as well as national standards. In addition, Pearson Interactive Science students had marginally significant higher test scores on the TerraNova science test as compared to control students.

Examination by subtests revealed that Pearson Interactive Science students showed higher levels of performance than control students on the Scientific Inquiry, Science & Technology and Life Science subtests of the TerraNova. Moreover, they outperformed students using other science programs on the multiple-choice items, which primarily measured science facts and concepts, and fill in the blank items, which primarily measure science vocabulary, of the Developed Science test.

The small to moderate effect sizes obtained in this study (d=.33 to .46) would be considered meaningful in the educational research literature. These effect sizes translate to Pearson Interactive Science students being 18 percentile points higher than control students on the Developed Science test, and 13 percentile points higher on the TerraNova science test.

Do effects on student science performance between Pearson Interactive Science and control students differ across types of students or control programs?

Results by student subgroups (i.e., grade, gender, minority status, free/reduced lunch, special education, English Language Learner, and science level) showed that there were no significant subgroup effects. This means that there was no difference between treatment and control students within these subgroups—both Pearson Interactive Science students and those using other science programs performed similarly at post-testing after controlling for pretest performance. In addition, no significant differences were observed for type of control program. It should be noted that the lack of significant differences may be due to the limited number of students within subgroups; therefore, sufficient power to detect small to moderate effects was only present in the overall analyses.

Does participation in Pearson Interactive Science result in other positive outcomes (e.g., positive attitudes towards science, etc.)?

While the main focus of the Pearson Interactive Science program is to improve upon important science skills and understanding, other measures were included to explore if Pearson Interactive Science was associated with positive impacts on student and teacher attitudes, and classroom practices. Results showed that while the Pearson Interactive Science program produced positive effects on student learning, this did not always translate to positive changes in student and teacher attitudinal outcomes. For example, students using other science programs felt more strongly about their science abilities and enjoyed science more as compared to

students using Pearson Interactive Science. Furthermore, control students indicated that their science programs prepared them to do well in state/national tests and future science courses to a greater extent than treatment students. Control teachers also generally had higher perceptions about their programs' assistance with differentiated instruction, progress monitoring, lesson preparation, and pacing as compared to treatment teachers.

That said, positive changes among Pearson Interactive Science teachers and students were observed in certain areas. For example, Pearson Interactive Science teachers reported being better prepared to teach various science content areas from Fall to Spring. In comparison to control teachers, Pearson Interactive Science teachers reported that they engaged in more activities designed to assist student's problem-solving skills and tended to emphasize test taking skills, science review, and inquiry skill concepts to a greater extent than control teachers, though differences were not significant. Students using the Pearson Interactive Science felt that the Write-In Student Edition provided them with useful information to learn and understand science which was facilitated by the lab zones and visual representations. Teachers also noted that being able to write in the Write-In Student Editions helped with student engagement, learning, and a sense of pride in their work. Additionally, the vast majority of teachers and students felt that the Pearson Interactive Science program helped students make connections between science, real world applications, and other subject areas.

What did users of Pearson Interactive Science think about the program?

Approximately 87.5% of treatment teachers and 80% of treatment students reported enjoying the Pearson Interactive Science program. The majority of teachers and students also reported that they would like to use the program during the following school year. Students and teachers felt the program was easy to understand, engaging and well-organized. Furthermore, when treatment teachers and students were asked to compare the Pearson Interactive Science program to their prior year's science program on various aspects (e.g., overall quality, labs, resources, organization, etc.), teachers and students generally rated the Pearson Interactive Science program as better than their prior program.

Teachers noted a variety of specific program components when asked to identify the three things they liked best about the Pearson Interactive Science program. However, a few items emerged as favorites from many teachers, including:

- Write-In Student Edition
- Lab Activities
- Online Digital Path

Teachers reported that they really liked the Write-In Student Edition in that students could write in them and actively participate and interact with the text. Teachers also mentioned that they liked the student ownership aspect of the consumable Write-In Student Edition. Despite some critiques regarding the lab activities (e.g., some take too much time to complete and set up, are not meaningful, etc.) most of the teachers indicated that they liked the variety of labs available as well as the lab materials that were provided with the program. As well, a majority of teachers reported that they liked the Online Digital Path especially the ability to edit worksheets, labs and tests/quizzes.

In sum, results from this one-year RCT show that students who use the Pearson Interactive Science program perform significantly better than students using other science programs across multiple areas of science content areas and types of test items. Such positive treatment effects were observed across different curricula in that Pearson Interactive Science students outperformed control students who used inquiry-based and traditional basal programs. The findings from this RCT all point toward the conclusion that the Pearson Interactive Science program is an effective program that helps middle school students attain critical science skills.

Project Background

"The success of the United States in the 21st century – its wealth and welfare – will depend on the ideas and skills of its population. These have always been the Nation's most important assets. As the world becomes increasingly technological, the value of these national assets will be determined in no small measure by the effectiveness of science, technology, engineering, and mathematics (STEM) education in the United States. STEM education will determine whether the United States will remain a leader among nations and whether we will be able to solve immense challenges in such areas as energy, health, environmental protection, and national security. It will help produce the capable and flexible workforce needed to compete in a global marketplace. It will ensure our society continues to make fundamental discoveries and to advance our understanding of ourselves, our planet, and the universe. It will generate the scientists, technologists, engineers, and mathematicians who will create the new ideas, new products, and entirely new industries of the 21st century."
(President's Council of Advisors on Science and Technology (PCAST), September 2010)

With the ever-increasing demands of a science and technology based global economy, it is essential that the youth of today, our leaders and inventors of tomorrow, be able to think critically and excel in science. Students who hope to succeed in future educational pursuits and/or career endeavors must have a strong science foundation regardless of where their educational and career goals are headed. Science proficiency has become a necessity

for students hoping to achieve success in the wider world. It is no longer a bonus subject, but rather a required core component of any educational program intending to produce students that are able to think critically, analyze complex situations and possess the tools they need to function successfully in a global market.

Unfortunately, we are falling behind other countries in preparing our students to succeed in science. According to the National Assessment of Education Progress report (NAEP, 2009), only 30% of 8th grade students performed at or above proficiency in science. As well, results from the Trends in International Mathematics and Science Study (TIMSS, 2009) showed that among 8th graders, the percentage of U.S. students performing at or above the advanced benchmark in science was lower in 2007 than in 1999 (10 vs. 12 percent).   Not only are U.S. students falling behind other countries in science, they are falling behind U.S. benchmarks set in previous years. This steady decline in science performance is a cause for concern, especially given the backdrop of the No Child Left Behind Act (NCLB) of 2001, which enacted the requirement that by the 2007-2008 school year, states must administer science assessments at least three times during a student's academic career.

Such emphasis on attainment of state standards and performance on state assessments in the area of science has highlighted a profound need to learn about "what works" in science education. In an effort to further support science achievement and education in general, the Obama administration enacted the American Recovery and Reinvestment Act (Feb. 2009), which included the $5 billion Race to the Top fund, awarding districts who make advanced reforms, including reforms in

science education. Accordingly, as educators strive to achieve better results in science they are requiring documented, evidence based, research-proven interventions indicating that the educational curricula produced by publishers will generate demonstrable, positive impacts on student science achievement.

"The preponderance of evidence provided by meta-analyses and evaluations of individual curricula seem to confirm that inquiry-based science curricula produce larger effects on student achievement than do the more 'traditional' science curricula (Clewell et al., 2004, p. 9).

To help address the large gap in secondary students' science skills that is facing our nation's youth, Pearson Publishers developed a new science program that blends print and digital formats to engage students, teach for understanding, and promote success in science. The 2011 Pearson Interactive Science (PIS) program is an inquiry-based middle school science program that incorporates prior research on effective science instruction and seeks to improve upon how science is being taught in classrooms by: 1) embedding inquiry-based teaching strategies into science instruction to promote higher-order thinking skills and student engagement; 2) designing a science curriculum that addresses the latest state and national science standards; and 3) promoting real-world connections so that students have ample opportunity to apply what they learn – thereby continually reinforcing and emphasizing the relevance of science in their everyday life.

The 2011 Pearson Interactive Science program consists of 12 modules in the areas of Earth Science, Life Science, Physical Science, and Science and Technology which are distributed as interactive Write-In Student Editions[1]. The program contains nearly 1,000 individual lessons – allowing schools and teachers a great deal of flexibility in tailoring content, scope and sequence so as to address state and local standards and ensure that necessary content is covered prior to state assessment cycles.

For teachers, the Pearson Interactive Science program provides a comprehensive resource for lesson planning, devising lab activities, and engaging students in science content that may be outside their area of expertise or training. The program incorporates Understanding By Design, an instructional model that places big science ideas into student-friendly all encompassing questions about science. In addition, lessons are organized around an inquiry-based process which focuses upon the 5Es: 1) Engage; 2) Explore; 3) Explain; 4) Extend; and 5) Evaluate. Together, these features represent a model of inquiry-learning that lends itself to higher-order thinking skills, understanding and critical thinking. For students, the Pearson Interactive Science program presents real-world information that is personally relevant and socially engaging. The text is designed so students can make their own interpretations of the material and self-assess their understanding of the information presented.

Planning, Research, and Evaluation Services (PRES Associates) Inc.[2], conducted a one-year experimental study to examine the effectiveness of the 2011 Pearson Interactive Science program in helping secondary students improve their science

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[1] "Write-In Student Editions" are a combination of a student text and a workbook. Students are able to use their Write-In Student Edition in an interactive manner, including writing in their Write-In Student Edition and keeping it as a journal of their science learning.
[2] PRES Associates, Inc. is an external, independent, educational research firm with over 20 years of experience in applied educational research and evaluation.

skills and understanding of important science concepts. This randomized control trial (RCT) was conducted in 6-8th grade classrooms during the 2010-2011 school year.

Project Overview

The overarching purpose of this study was to rigorously evaluate the effectiveness of the 2011 Pearson Interactive Science program in helping middle school students attain understanding and skills in science. Specifically, this study was designed to address the following research questions:

- Does science ability improve as a result of participation in the Pearson Interactive Science program?

- Do changes in science performance among Pearson Interactive Science students vary by different types of students (e.g., grade, gender, science level, economically disadvantaged status) and levels of implementation?

- Does using Pearson Interactive Science result in increased student achievement as compared to other types of science programs?

- Do effects of Pearson Interactive Science on student science performance vary as a function of different student characteristics and control programs?

- Does participation in Pearson Interactive Science result in other positive outcomes (e.g., positive attitudes towards science and so forth)?

- What do users of the Pearson Interactive Science program think about the programs? What aspects of the programs do they find most useful? Least useful? What, if any, suggestions for program improvement do they have?

This report presents descriptive information and results of the RCT. The remainder of this report includes: 1) a description of the design and methodology; 2) sample and site information, including descriptions of PIS implementation; 3) results of the evaluation; and 4) conclusions. In addition, an accompanying Technical Report presents detailed statistical results of all baseline, attrition and assessment analyses, including the analytical goals and framework employed.

Methodology

The present study was designed to address all standards and criteria described in the What Works Clearinghouse (WWC) Study Review Standards (2008)[3] and the Joint Committee on Standards for Educational Evaluation's Program Evaluation Standards (1994). The research design consisted of a one-year randomized control trial, with random assignment of 15 teachers, and for 9 additional teachers random assignment of *classes,* to a treatment (i.e., use of Pearson Interactive Science) or control group[4]. Random assignment occurred at the class level for 9 teachers at 6

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[3] A crosswalk which shows how this study meets the WWC's review standards is provided in Appendix A.
[4] Teacher/class level of random assignment was conducted for several reasons. From a research design perspective, it is desirable to conduct random assignment at the lowest level possible given both the nature of the intervention and the practical realities of the settings the research is being conducted in. In addition, using the lowest level of random assignment possible is a design strategy used to eliminate competing explanations for any observed differences and to enhance the ability of the study to make causal inferences.

school sites because there were no other science teachers available at the same grade level[5]. Other important design and methodological features include:

- The study was conducted in the 6-8th grades[6] during the 2010-11 school year (n=1362 students).

- Science teachers/classes (n=36) were randomly assigned to the treatment (n= 19) or control conditions (n= 17) prior to the onset of the study.

- Clear site selection criteria were established along with accompanying rationale.

- Extensive background data was collected on instructional activities and materials used in classrooms so as to describe the context in which science instruction took place.

- The threat of differential attrition was addressed via: 1) the initial site selection process[7]; 2) random assignment among teachers/classes within schools to help ensure that attrition was relatively constant across both treatment and control groups; and 3) the characteristics of students who left were statistically compared between treatment and control groups.

- Implementation guidelines and monitoring procedures[8] were embedded to ensure the fidelity of treatment implementation. Furthermore, monitoring

mechanisms were put into place to address potential threats to validity such as contamination (i.e., students not assigned to use PIS who end up using PIS) and attrition (i.e., students dropping out). These included: a) site visits (1 for orientation, 1 in Fall and 1 in Spring); and b) teacher monthly activity logs.

- Assessments measuring concepts in Life, Earth, and Physical Science as well as Science & Technology at the middle school level were developed based on released items from existing international, national and state science exams. In addition, the norm-referenced *TerraNova* Science test was used. The assessments consisted of both multiple-choice and open-response test items that were aligned to content that is typical in middle school science courses.

- The study employed pre/post measures of, among other things: (1) student performance; (2) student attitudes regarding science; and (3) teacher characteristics, attitudes towards student learning, and perceptions of the PIS program.

- Student assessments, surveys, and classroom observation forms are valid and reliable as shown by technical documentation and statistical analyses performed.

- The study employed the use of statistical controls as well as random assignment to establish initial group equivalence[9].

- Analyses of assessment data were primarily conducted via multilevel models to take into account clustering and baseline differences.

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[5] Teachers were thoroughly debriefed at the onset of the study about the importance of avoiding contamination and there was no evidence of contamination found over the course of the study.
[6] The study was conducted at these grade levels in order to evaluate all PIS modules. Since there is variation in terms of when science concepts are taught, having the study encompass all middle school grades allowed researchers to more fully evaluate this program.
[7] Sites that historically had more than 20% student attrition were not used in the study.
[8] Training provided and implementation guidelines reflect how the PIS program should typically be used in schools.

[9] Random assignment helps to create group equivalence. However, it must be noted that with small sample sizes random assignment in and of itself does not assure initial group equivalence (Lipsey, 1990).

In addition, the teacher/class level of analysis employed matches the unit of random assignment.

Table 1 displays the timeline for the important study activities during the RCT. More detailed information on these activities, as well as measures used, is provided in the following section.

Measures

This section reviews the outcome and assessment measures that were administered, including descriptions of the items, and available reliability and validity information.

Student Assessments: In order to enhance the sensitivity of the RCT to detect any effects associated with the PIS program, two assessments were used: (1) *TerraNova* Science test; and (2) a custom developed science test. Following a thorough literature review of existing standardized, published assessments to identify tests that were valid, reliable, sensitive, as well as aligned to national science standards, it was determined that there were no readily available science assessments that fully captured the range of scientific knowledge and skills that students can potentially gain

in middle school science classrooms. Assessments available typically consisted of state science exams that were aligned to specific state science standards, and/or did not give students adequate opportunities to explain their reasoning and to illustrate their analytical thinking process. As such, in addition to the *TerraNova*, a supplemental assessment was developed that included fill-in the blank and constructed response test items.

♦ *Developed Science Assessments*: Prior to the study, information was obtained from participating schools on the science topic areas that would be covered during the school year for each grade level. Because coverage of science concepts varied across schools and across grade levels, an item bank was first created that covered typical middle school science concepts in Life, Earth and Physical Science, and Science & Technology. Items were then drawn from the item bank in order to customize assessments for each grade level and school; both treatment and control classes within the same grade level and school took the same version of the test. The assessments were worth 50 points

Table 1. Pearson Interactive Science RCT: Timeline of Activities

2010-11	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.-Feb.	Mar.	April	May	June
Training and Program Implementation Begins	♦	♦								
Follow Up Trainings Occurred (2-3)				*Varied for each site*						
Assessments and Surveys Administered		♦	♦			♦			♦	♦
Site Observations			♦	♦			♦	♦	♦	
Teacher Logs*		♦	♦	♦	♦	♦	♦	♦	♦	♦

*Note that teachers completed monthly teacher logs that monitor instructional activities and the use of program and other resources.

and contained 30 multiple choice items, 10 fill in the blank items and 5 short answer items (each worth 2 points). The vast majority of items were drawn from released state science assessments, TIMSS, and NAEP, although in a very few instances custom-developed items were embedded to measure content taught.

♦ *TerraNova*: The *TerraNova*, Third Edition Complete Battery Science test was also administered so that information on student performance could be obtained using a national standardized science test. The *TerraNova* exam is a norm referenced achievement test developed by CTB McGraw-Hill, which was standardized in 2007 using a nationally representative sample. The science portion of the test was evaluated in a series of pilot studies to determine grade-level appropriateness and only items with statistics confirming grade-level appropriateness and instructional relevance were included in the test. The science test consists of 40 multiple choice questions measuring the following science areas: Science Inquiry, Physical Science, Life Science, Earth and Space Science, Science and Technology, and Scientific Inquiry. Students were administered the science portion of the *TerraNova* Level 16, 17 and 18 tests for grades 6, 7 and 8, respectively. The *TerraNova* has demonstrated reliabilities ranging from .89 to .93 in the Fall.

In addition to content specific test scores in the areas of Life, Earth, Physical, Scientific Inquiry, and Science &

Technology, an overall score was created based on data from all test items taken (Total Science Score). In order to obtain more specific information on the areas impacted by the PIS program, multiple-choice and fill-in-the-blank items (primarily measuring science facts and vocabulary) and open-response items (primarily measuring scientific reasoning skills and application of science concepts) from the Developed Science test were analyzed separately. For all analyses of custom assessments, percent correct was the metric used. For analyses involving overall performance on the *TerraNova* Science test, the scale score was used. For analyses of the *TerraNova* content areas, percent correct was the metric used.

Student Survey: In an effort to examine other potential areas that may be influenced by the PIS program, a student survey was developed primarily to measure:

♦ Perceived science ability *(e.g. I'm good at science)*
♦ Enjoyment of science *(e.g. I look forward to my science class)*
♦ Perceived relevance/usefulness of science *(e.g. Science is a worthwhile, necessary subject)*
♦ Science- and school-related effort and aspirations *(e.g. I study hard for science tests)*

The survey also included items on parental knowledge and support, classroom experiences and, in the Spring survey, satisfaction with their science program. These scales were included in order to obtain measures of the impact of the Pearson Middle Grades Science program on affective student outcomes and to measure potential variables that may serve as covariates as needed (e.g., parental support). While some items were created by PRES Associates, others were derived from additional

measures with published reliability and validity[10]. Internal consistency of the scales measuring attitudinal constructs range from .59 to .87. High scores represent a very positive attitude or strong agreement (scales are from 1 to 5).

Teacher Survey: Information was collected via surveys from all participating teachers. In addition to obtaining teacher background and demographic information, the survey was developed to measure:

- Current and past classroom and instructional practices
- Science-related preparation and knowledge
- Teacher knowledge of effective teaching practices (including those specific to science instruction)
- Organizational factors/context
- Attitudes about student learning and effective science instruction
- Attitudes about science curriculum

These measures were obtained to examine affective outcomes as well as to gather background information (e.g., years of experience, education, etc.). Some items were obtained from existing scales, while others were developed for the study[11]. Internal consistency of the scales measuring attitudinal constructs range from .64 to .89. High scores represent a very positive

attitude or strong agreement (scales are from 1 to 5).

Classroom Observations: A classroom observation form was developed to guide observations. This form was largely based on existing protocols that have been used across the nation[12]. Modifications were made to reflect content and practices typical of middle school science classes, as well as to examine implementation of key components of the Pearson Interactive Science program. Researchers conducting site visits and using classroom observation forms were trained extensively until a high level of agreement (.90 and above) was demonstrated among observers on the various quantitative and qualitative items.

Procedures

To ensure that all treatment teachers participating in the study had sufficient knowledge and skills to successfully implement Pearson Interactive Science, teachers were provided with both implementation guidelines and PIS specific training prior to implementation. In addition, monitoring procedures (via monthly instructional logs completed by teachers and classroom observations and interviews) were instituted to measure the extent to which teachers were implementing a similar instructional model as outlined by the Pearson Interactive Science program implementation guidelines.

The following section presents the procedures used to assist teachers in implementing the PIS program, the monitoring procedures used by evaluators to determine treatment fidelity, methods used

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[10] Portions of this survey were adapted from the: *2003 TIMSS Student Questionnaire-8th Grade*; O'Neill and Abedi (1996) *Reliability and Validity of a State Metacognitive Inventory* (Los Angeles: National Center for Research on Evaluation, Standards, and Student Testing (CRESST)); and the *Fennema-Sherman Math Attitude Scale*.

[11] Items in this survey were developed by PRES Associates and modified from the *Trends in International Mathematics and Science Study (TIMSS) 2003 Teacher Questionnaire Science Grade 8* (Washington, DC: National Center For Education Statistics) and the *2000 National Survey of Science and Mathematics Education Science Questionnaire* (Rockville, MD: Westat).

[12] The Classroom Observation Form was derived from the following protocols: Horizon Research's *Local Systematic Change Professional Development Classroom Observation Protocol*, and the *Texas Collaborative for Excellence in Teacher Preparation Classroom Observation Protocol*.

to obtain program feedback, and the test administration and scoring procedures employed.

TRAINING

The training model for the Pearson Interactive Science study was designed to provide teachers with the necessary background and practical experiences to begin implementing the program with fidelity from the start of the 2010-2011 school year.

Teachers met with a Pearson professional trainer for approximately 5-6 hours at the start of the 2010-2011 school year. During the training, the trainer clearly described the philosophy of the program, provided an overview of all program components and clearly indicated which components teachers were required to use. The Pearson professional trainer also helped teachers to register classes online and specifically addressed technological component use, access and integration into each lesson. A strong emphasis was placed on which components were key and required, versus those that were optional. The trainer also modeled a sample lesson to demonstrate how teachers should fully implement the program (this included lesson flow and language to use).

In addition to the initial in-depth training, follow-up sessions were conducted at each site. The follow-up training sessions were somewhat less formal than the initial training and allowed opportunities for teachers to ask questions and receive additional training on program components that were not required. This is because by the time the follow up trainings occurred, many teachers had become comfortable and proficient using the required components of the program and were ready to begin incorporating many of the additional

resources provided by the program. For about half of the school sites, during Training Session Two the trainer observed the teachers using the Pearson Interactive Science program in their treatment classes during the first part of the day and conducted the training later in the day. For the remainder of the school sites the training took place in the morning and the trainer observed treatment classes in the afternoon and was available for further comments/clarifications after class.

A third training occurred only for Sites B and I as they had teachers that did not start to use the program until second semester. Their third training session took place at the start of second semester and served as a refresher for those teachers before they were to start using the program. The trainer provided a brief review of the whole program including an overview on the philosophy and pedagogy of the program and a walk through of the Teacher's Edition, Student Edition and ancillaries. The trainer then focused primarily on the use of digital components based on what teachers indicated they needed or wanted to use. Table 2 shows training received by each site.

Table 2. 2010-11 Training Sessions by Site

	Training Session 1: Initial	Training Session2: Follow-up	Training Session3: Follow-up
Site A	8/4	9/3	
Site B	8/4	9/3	1/6
Site C	11/13	1/6	
Site D	8/6	10/7	
Site E	8/20	11/1	
Site F	9/1	10/25	
Site G	8/11	9/29	
Site H	8/11	9/29	
Site I	8/13	9/28	1/21

Another item of note is that the focus of these trainings was not on general science professional development but rather on the vision of the Pearson Interactive Science program, the use of both print and digital

materials and implementation of the essential components, and how the program could best be used to effectively help students learn science.

IMPLEMENTATION GUIDELINES

Pearson Interactive Science teachers were provided with detailed implementation guidelines at the onset of the study in order to ensure they had a concise understanding of the essential program components and design basis of the PIS program. Implementation guidelines were based on key program components and pedagogy as identified by Pearson product managers and editorial staff. The guidelines were developed by PRES Associates with final input and revisions from Pearson. These offered detailed direction on how the program should be used in the classroom, as well as what parts of the program were considered key (and required), versus what program elements were considered optional. The key components of the program include:

- ♦ The Big Question
- ♦ Check Your Understanding
- ♦ My Planet Diary
- ♦ Vocabulary
- ♦ Figures/Activity Art/Animations
- ♦ Apply It!
- ♦ Do the Math!
- ♦ Untamed Science Video
- ♦ Assess Your Understanding
- ♦ Inquiry Warm-Up Lab (1 per lesson)
- ♦ Quick Lab (1 per lesson)
- ♦ Lab Investigation (1 per chapter)

For a full description of these key components, please see Appendix B.

PROGRAM MONITORING

Teacher Logs. Online teacher logs were used so that program implementation could be monitored on a real-time basis and to identify any issues or local events that had the potential to influence study results. Teachers were instructed to complete these on a monthly basis from September through May/June. The primary purpose of the teacher logs was to monitor program implementation and fidelity among Pearson Interactive Science classes. Researchers also collected monthly logs from control classes so instructional activities and content covered could be noted and also to monitor the extent to which any contamination may have occurred. Such background information provided researchers with a detailed data source on what was occurring in treatment and control classrooms with respect to science instruction and practices. It also allowed researchers to identify areas of overlap in terms of content taught and instructional activities. The extent to which there are similarities and differences between classrooms can have an impact on observed differences between treatment and control classes and effect sizes thus, it is important to take these factors into consideration when interpreting study results. Information obtained via these logs included changes in student rosters, typical classroom activities, use of other print resources and related exercises (including homework and independent practice), the degree to which technology was used and in what ways, use of labs and time spent on them, and coverage of science topics and content, and for treatment classes, use of key Pearson Interactive Science program components, both print and digital.

Results showed that teachers had, on average, a 87% completion rate. The ranges were 44% to 100%[13]. Teachers were contacted after failure to complete teacher logs each month. In cases of noncompliance, the school liaison was asked to consult with the teacher to see if there was anything that could be done to assist the teacher in completing the logs and for the most part this was an effective practice and log completion was relatively high with teachers missing only one log on average. For the one teacher that did not have a high completion rate[14], a more extensive implementation checklist was completed in the Spring to ensure that information on implementation was available from this teacher.

Classroom Observation. Classroom observations were conducted for treatment and control classes during the Fall (October-November, 2010) and the Spring (April-May, 2011). The purpose of these observations was to better understand the instructional approaches and materials used by teachers with their students and to identify differences and similarities between classes taught by teachers that were randomly assigned to treatment or control conditions. Specifically, observations focused on how classroom activities were structured, what and how print and digital materials were used, and characteristics of the class including student engagement, classroom environment and culture, and teacher-student interactions. In addition, teachers were interviewed after the observations to obtain more specific information on the representativeness of the lesson, resources used, ability levels of the students, assessment practices, pacing,

independent practices, test preparation strategies and feedback related to the program. The observations also allowed researchers to examine the extent to which class and teacher level differences could have influenced study results and to examine the threat of possible contamination between treatment and control classes.

TEST/SURVEY ADMINISTRATION AND SCORING

Assessments were administered during two time periods over the course of the study: (1) Fall (September through October 2010); and (2) Spring (May through June 2011)[15], with some exceptions. School Site I administered assessments four times over the course of the study (beginning and end of each semester) to classes that were only a semester long (a full year of content was covered in one semester). Schools B and C were also semester long but only occurred for one semester. School D completed post assessments in March due to a rigorous state testing schedule. For the *TerraNova* Science test, the test publisher's standard testing procedures were followed. For the Developed Science assessments, test administration directions were provided to all teachers. Teachers were instructed to contact PRES Associates if they needed additional guidance related to assessment administration. The short answer portion of the test was scored by an external university student and former teacher who were blind to group assignment.

Student and teacher surveys were completed during the same time periods as the assessments (i.e., Fall 2010 and Spring 2011 for year long courses and at the

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[13] Calculation based on 9 months in which teachers were asked to report on their activities.
[14] This study teacher left in the last month of the study. Therefore, the study liaison completed the implementation checklist based on teacher's lesson plans.

[15] Administration dates depended on the school's start and end date. Teachers within each school followed a similar testing schedule. Generally, administration occurred within 1 month after the school year commenced (pretest) and within 1 month prior to the end of the school year (posttest).

beginning and end of each semester for semester long courses).

Site Selection Criteria

Criteria for developing an initial list of schools to be contacted for possible inclusion in the study included geographical diversity across different states, public schools, and a minimum school size of 600 so that a sufficient number of teachers would be available for purposes of random assignment. A list of schools meeting the aforementioned criteria was contacted and, of those, 12 indicated initial interest. Of these, 9 met additional criteria for study participation as indicated below and were selected to participate in the research study.

- Schools had to have multiple science teachers at each grade level, or be willing to do class level random assignment if this was not the case;
- Historically low student mobility rates (less than 20%) as a means of helping control for the threat of attrition;
- Willingness/commitment to fully participate in all aspects of the study (e.g., random assignment and data collection).

Other major criteria included: 1) that there be no other major science initiative(s) at the school; and 2) the typical science curricula employed by the school fell under the "comparison" programs which provided a contrast to the PIS program.

Sample Description

Site Characteristics

Nine schools participated in the study. Schools were located in rural, suburban, and urban areas and were geographically dispersed across the U.S in the states of Arizona, Kentucky, Nevada, New York, Ohio, and Pennsylvania. A detailed case study of each of the schools is available in Appendix C.

Table 3 on the following page shows the school-wide characteristics of each of the participating sites. As shown, at three sites school populations were ethnically diverse, and at four sites a substantial proportion of students were classified as economically disadvantaged. Characteristics specific to the study participants are provided in Table 4.

Table 3. School-Wide Student Demographics

School	School Size	Ethnic Breakdown	% of Limited English Proficient	% Economically Disadvantaged	% by Gender
Site A *Arizona* **Grades 7-8**	724	87% White, not Hispanic 9% Hispanic <1% American Indian 1% Black, not Hispanic 2% Asian/Pacific Islander	<1%	7%	50% Male 50% Female
Site B *Arizona* **Grades KG-6**	542	88% White, not Hispanic 8% Hispanic <1% American Indian <1% Black, not Hispanic 2% Asian/Pacific Islander	2%	5%	50% Male 50% Female
Site C *Arizona* **Grades KG-6**	568	90% White, not Hispanic 8% Hispanic <1% American Indian <1% Black, not Hispanic <1% Asian/Pacific Islander	3%	6%	52% Male 48% Female
Site D *Kentucky* **Grades 6-8**	669	61% White, not Hispanic 4% Hispanic <1% American Indian 34% Black, not Hispanic 1% Asian/Pacific Islander	NR	49%	51% Male 49% Female
Site E *Nevada* **Grades K-12**	373	20% White, not Hispanic 53% Hispanic <1% American Indian 23% Black, not Hispanic <1% Asian/Pacific Islander	NR	NR	53% Male 47% Female
Site F *New York* **Grades 6-8**	1051	68% White, not Hispanic 4% Hispanic <1% American Indian 15% Black, not Hispanic 12% Asian/Pacific Islander	1%	9%	54% Male 46% Female

Continued.

Table 3 Continued. School-Wide Student Demographics

School	School Size	Ethnic Breakdown	% of Limited English Proficient	% Economically Disadvantaged	% by Gender
Site G *Ohio* **Grades 7-8**	330	99% White, not Hispanic <1% Black, not Hispanic	NR	41%	54% Male 46% Female
Site H *Ohio* **Grades 6-12**	303	99% White, not Hispanic <1% Black, not Hispanic <1% Hispanic	NR	45%	49% Male 51% Female
Site I *Pennsylvania* **Grades 6-8**	624	97% White, not Hispanic 2% Black, not Hispanic <1% American Indian	NR	39%	54% Male 46% Female
National Population		**White-53.5% Hispanic-21.9% African Am.-17.6% Asian/Pacific Islander-5% Native American 1.2% Other 0.5%**	**9.6%**	**45.4%**	**Male-50.8% Female-48.0%**

Data on National Population was obtained from U.S. Department of Commerce, Census Bureau, Current Population Survey (CPS), and U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD). Figures represent distributions across all grade levels and reported for 2009. School data obtained from respective State Department of Education websites. NR=Not Reported

Student Characteristics

The final sample consisted of 1362 students (634 control; 728 treatment) in 54 classrooms (26 control; 28 treatment) with 23 teachers (7 control; 7 treatment; 9 teaching both control and treatment[16]). The study participants were in the 6th to 8th grade. Table 4 presents the demographic distribution among study participants. Note that only students who remained in the study throughout the year are included in this table and in the final analyses. The sample was primarily White (79%), with a majority of students receiving free/reduced lunch (51%).

Preliminary analyses[17] were performed to examine whether baseline differences existed as a function of student demographics. Chi-square analyses on the

Table 4. Student Demographics Distributions*

Characteristics		Control (n=634)		PIS (n=728)		Total (n=1362)		National
		Count	Percent	Count	Percent	Count	Percent	Percent
Gender ($\chi^2(1)=0.292$, p=.59)	Male	326	51.4%	385	52.9%	711	52.2%	50.2%
	Female	308	48.6%	343	47.1%	651	47.8%	49.8%
Ethnicity ($\chi^2(1)_{minority}=0.84$, p=.36)	White	494	77.9%	582	79.9%	1076	79.0%	55.0%
	Hispanic	45	7.1%	69	9.5%	114	8.4%	21.5%
	African American	50	7.9%	43	5.9%	93	6.8%	17.0%
	Asian	28	4.4%	28	3.8%	56	4.1%	5.0%
	Other	17	2.7%	6	0.8%	23	1.7%	1.2%
Grade ($\chi^2(2)=13.43$, p=.001)	6th	202	31.9%	173	23.8%	375	27.5%	--
	7th	218	34.4%	253	34.8%	471	34.6%	--
	8th	214	33.8%	302	41.5%	516	37.9%	--
Subpopulations								
($\chi^2(1)=9.30$, p=.002)	Free/Reduced Lunch Status	85	60.3%	58	42.0%	143	51.3%	45.4%
($\chi^2(1)=1.48$, p=.23)	Limited English Proficiency	42	6.6%	37	5.1%	79	5.8%	9.6%
($\chi^2(1)=3.09$, p=.08)	Special Ed Status	56	8.8%	46	6.3%	102	7.5%	13.6%
($\chi^2(2)=5.11$, p=.08)	Low Science Level	131	20.9%	131	18.5%	262	19.7%	--
	Mid Science Level	280	44.7%	291	41.2%	571	42.8%	--
	High Science Level	215	34.3%	285	40.3%	500	37.5%	--

*Counts (and percents) do not include missing information. Ability level was determined by percentile standing on the TerraNova pretest. Students scoring at the top 33rd percentile were classified as high, students scoring at the bottom 33rd percentile were classified as low, and students scoring at the middle 66th percentile were classified as mid level.

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[16] As previously noted, nine teachers at schools B, C, E, G, H, and I had classes that were randomly assigned. This is because there were no comparison teachers available in who taught the same grade level.

[17] All details regarding analyses on baseline differences and attrition analyses are provided in the Technical Report.

demographic characteristics noted in Table 4 showed two significant differences, $p<.05$[18]. In particular, there was a higher proportion of 8th graders and a lower proportion 6th graders in the treatment group. Additionally, among the schools (n=3) reporting data on free/reduced lunch, there was a higher proportion of students receiving free/reduced lunch in the control group than the treatment group. That said, data is limited to only three schools and as such, it is unclear if differences exist across all nine schools.

Differences in baseline science performance were also examined based on analyses of pretest scores. Student level t-test analyses revealed significant differences on the *TerraNova* and Developed Science Tests, $p<.05,$ see Table 5. Treatment students had significantly higher pretest scores than control students. Thus, treatment and control students were not equivalent with respect to pretest science performance.

Differences on other student characteristics were also examined. Results showed no significant differences between treatment and control students in perceived parental support, amount of English spoken at home, mother's educational background, father's educational background, school engagement, perceived science ability, science enjoyment, science effort/motivation, and educational aspirations. Differences, however, were observed in perceived science anxiety and perceived support from teacher, $p<.05.$ Treatment students perceived greater support from their teacher and higher levels of science anxiety as compared to control students. As a result of these baseline differences, analyses of program effects controlled for these factors.

Attrition Analysis

Both measurement attrition (i.e., missing data due to students not completing assessments) and dropout attrition (i.e., missing data due to students leaving the study) were examined. Details on the attrition analysis are presented in the accompanying Technical Report, and are summarized herein. There was an overall dropout attrition of 6.9% (n=101) due to students leaving school or moving from

Table 5. Sample Size, Means, Standard Deviations, and *t*-test (Student Level) Results for Assessments at Pre-testing

Pretest*	Group	N	Mean	Std. Dev.	*t*	Sig. Level
TerraNova Science Test	PIS	626	678.14	33.56	2.80	.005
	Control	707	672.97	33.59		
Developed Science Test	PIS	665	36.89	12.35	5.38	<.001
	Control	620	33.25	11.90		

[18] "Significant" means that we can be 95% or more confident that the observed differences are real. If the significance level is less than or equal to .05, then the differences are considered statistically significant. If this value is greater than .05, this means that any observed differences are not statistically significant and may be interpreted as inconclusive. However, at times this may be referred to as "marginally significant." In this case, the criterion is more liberal and means that we can be 90% or more confident that the observed differences are real.

treatment to control classes (or vice versa). There were no significant relationships observed between students who "dropped out" and group; as such, dropout attrition is unlikely to bias results.

With respect to measurement attrition, chi-square analyses showed significant relationships between the proportion of students who provided and did not provide data and group. Specifically, a higher proportion of treatment students did not provide TerraNova and Developed Science pretests; however, the proportion was relatively small. Additional analyses were run to examine if there were any *performance* differences between those who completed tests and those that did not by group. Results showed no significant interaction which means that results are unlikely to be biased due to measurement attrition. Moreover, given the relatively small sample of students that did not provide pre and post data (approximately 6% or 76 students), these differences are unlikely to bias results.

Teacher and Class Characteristics

There were 23 middle school science teachers who participated in the RCT. Teachers taught a total of 54 classes (28 treatment and 26 control). While 14 teachers were randomly assigned to conditions, 9 teachers at schools B, C, E, G, H, and I had classes that were randomly assigned and therefore, these teachers taught PIS and another science program depending on the class period. Random assignment occurred at the classroom level because there were no comparison teachers available—these teachers were the only teachers at the specific grade level.

Approximately 74% of teachers were female and 91% were Caucasian. In regards to educational background, 13% of teachers

held a Bachelor's degree and 87% of teachers held a Master's Degree, primarily in Education. Teacher experience ranged from 1 to 27 years, with the average number of years taught being 12.

With respect to differences among teachers, results showed no significant baseline differences across control and treatment teachers in terms of knowledge of NSTA standards, preparation to teach science via "best practices" strategies, preparation to teach various science topics, pedagogical approach (inquiry versus traditional), hours of professional development received over the last three years, number of formal courses taken in science, degree earned, and teaching experience, $p>.05$. There were also no differences on affective measures such as perceptions of control over teaching, perceived teacher collaboration and support, perceived support from administration and parents, access to ancillary resources to teach, access to technology, and attitudes towards technology use in the classroom, $p>.05$.

Classroom environment and implementation of various typical activities that occur in science classrooms were also analyzed based on information collected from the classroom observations, teacher logs, and teacher surveys. Results showed no significant differences between treatment and control classrooms in terms of classroom environment, classroom management time, instructional time, independent practice, homework, lab activities, provision of differentiated instruction, diversity of student activities, assessment use, and prior technology use by teachers and students, $p>.05$.

In summary, randomization was reasonably successful in producing equivalent treatment and control groups in

terms of student, classroom, and teacher characteristics. However, given significant differences among a few variables including pretest differences, care was taken to include variables that differed across the treatment and control groups as covariates in the analyses of program effects. Specifically, the following covariates were identified for inclusion in the multilevel model of program effects: 1) grade level, 2) student perceptions of teacher support, 3) student perceptions of science anxiety, 4) school, and 5) pretest performance.

Instructional Curricula

Researchers tried, to the extent possible, to select schools to participate in the study that used a control program that differed pedagogically from the intervention under study. Indeed, part of the site selection criteria included a review of the control curricula prior to approving a site for participation, to determine if the program was sufficiently distinct. For the Pearson Interactive Science RCT, participating schools used five distinct published science programs, with the exception of Schools D and F which used custom science curricula developed by school teachers. Most teachers taught a spiral curriculum covering various aspects of Life, Earth and Physical Science and therefore, depending on the school and grade level, different science concepts were taught due to state and local curricular guidelines which are typically aligned to state assessments. However, it is also important to note that within schools, there were similarities in content covered between treatment and control programs as teachers had to cover similar concepts regardless of the program used. The focus of this study was to examine the effects of an entire core curriculum and as such, it must be compared to other core curricula that teaches the same content area.

PEARSON INTERACTIVE SCIENCE

The philosophy behind the Pearson Interactive Science program is Understanding by Design (UbD), a lesson strategy that puts the big ideas of science into student-friendly big or essential questions about science. This backward design process begins with identifying the desired long term results prior to designing a program with activities, materials, or textbook content. Implementing the backwards design process takes place in three stages:

Stage 1: Identify desired results of instruction
Stage 2: Determine acceptable evidence
Stage 3: Plan learning experiences and instruction

In the UbD framework, the desired accomplishments serves as the focal point for the planning of all curriculum, instruction, and assessment and helps avoid superficial coverage. The goal of this UbD frame work is that students achieve deep understanding of ideas -- not just for "the test," but for life.

The chapters and lessons within the Pearson Interactive Science program are organized around the 5E's: engage, explore, explain, extend and evaluate. The user utilizes the 5e's to unlock the Big Question and facilitate Enduring Understanding, see Figure 1 below. The Big Question is designed to promote discussion, connect prior learning, foster a deeper understanding, promote inquiry and stimulate re-thinking.

Figure 1. The 5 E's in the Pearson Interactive Science Program
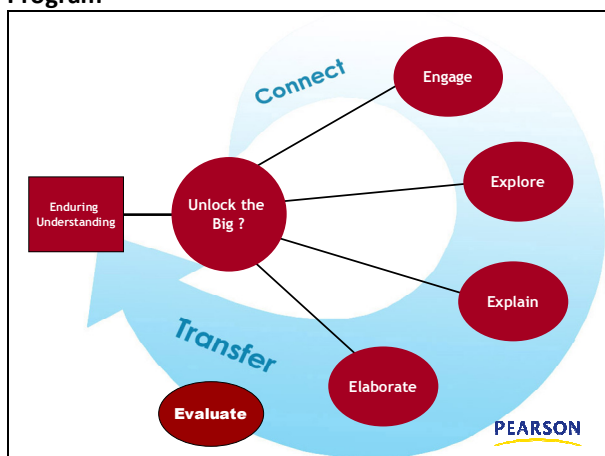
The activities included in the program as they relate to the 5E's are listed in the Figure 2. Other unique aspects of the Pearson Interactive Science program includes, student self-assessment as embedded in the Assess Your Understanding feature, the variety of interactivities embedded in the Figure Activities, math review integration embedded in Do the Math, a large choice of lab activities, as well as the support of reading and vocabulary development.

Figure 2. 5E's Lesson Components
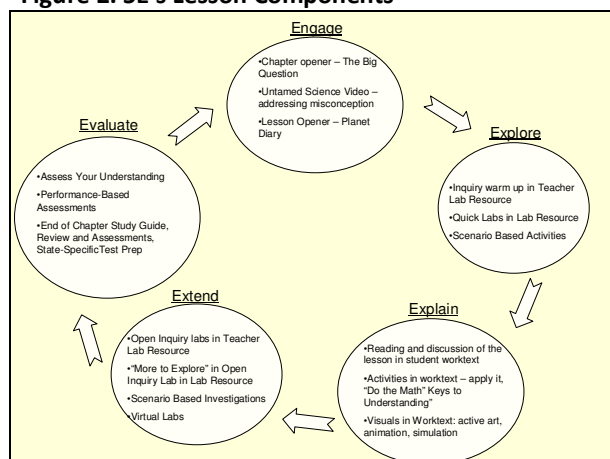
To accomplish the goals of the Pearson Interactive Science program, resources were designed to integrate digital technology, emphasize hands on inquiry, and provide differentiated learning, all of which are essential components of the program.

Resources include:

Student Resources
- Write-In Student Edition
- Interactive Digital Path

Teacher Resources
- Teacher's Edition
- Teacher's Lab Resource
- Program Guide
- Scenario Based Investigations
- DK Big Ideas Books
  - DK Visual Glossary
  - DK Volumes 1-6
- Multilingual Glossary
- Big Ideas Activities and Projects
- Interdisciplinary Activities
- Math Skill and Problem-Solving Handbook
- ELL Handbook
- Reading Strategies Handbook
- Inquiry Skill Handbook I
- Inquiry Skill Handbook II
- Inquiry Skill Handbook III
- Untamed Science videos DVD
- ExamView® Test Generator CD-ROM
- Professional Development at mypearsontraining.com

Digital Resources
- Student & Teacher Edition
- Program Resources & Editable worksheets
- Assessment Resources
- Lab Zone Activities
- Teacher PowerPoints
- Lesson by Lesson Blackline masters
- Interactive Digital Path

A key feature of the program is that student edition is a write-in resource, which gives them the opportunity to write in their own book and keep track of notes without having additional papers or folders. Generally, the pacing of the program is about one lesson per 2-4 days for a typical 50 minute class or about 2-4 weeks per chapter.

For a more detailed description of the program's key features and materials, see Appendix B-Implementation Guidelines.

CONTROL CURRICULA

The type of control curricula used by teachers varied between sites. Table 7 shows the programs used at each of the sites. Sites D and F did not follow a published textbook but rather used teacher and district made resources and only occasionally supplemented with textbook for supplemental reading and note-taking purposes. Schools used the same program across grade levels at the respective schools, except for Site E who used different

programs in grades 7 and 8. The control program varied across the school sites with Sites B and C using program 1, Site A using program 5, Sites E, G and I using program 3, Site E using program 2, and Site H using program 4. In addition, the teacher at Site B supplemented program 1 with program 5 for one unit.

Control program 1 uses a hands-on inquiry approach with lessons organized around lab investigations, rather than a modular chapter based arrangement. The program encourages students to make connections between evidence and explanations. Lessons are structured such that there is a clear "goal" and objectives for each lesson that are realized through science content, conducting investigations and building explanations. Multimedia activities are also woven into instruction providing visual demonstrations to supplement science content. The content taught is different according to the subject area, but the program's approach to science instruction and resources for all science content areas is consistent. Control program 1 is an

Table 7. Primary Control Curricula by Site

	Program 1	Program 2	Program 3	Program 4	Program 5	Teacher & District-created resources
Site A: AZ					Science – 2005	
Site B: AZ	Science-2004				Science – 2005	
Site C: AZ	Science-2004					
Site D: KY						Developed program
Site E: NV		Science-2001	Science-2001			
Site F: NY						Developed program
Site G: OH			Science-2009			
Site H: OH				Science-2000		
Site I: PA			Science-2007			

investigative program as compared to traditional, basal programs, with a focus on real-world applications and a number of hands-on explorations and labs throughout.

Control program 2 uses a modular, chapter based arrangement of lessons that includes lab activities and built in self-assessments. The program emphasizes a connection to other content areas of science lending to a greater understanding of science in real world contexts. Each chapter begins with a full length Lab Investigation activity to introduce the topic through a hands-on experience. Each lesson includes a quick lab activity, math activities that integrate math and science and an "Apply" feature to connect student knowledge to the real world. The program also includes feature articles following every chapter emphasizing Science and Technology. While the program is a blend of basal and inquiry teaching approaches, it leans more towards basal instruction for the core, while providing the option to bring in additional investigations as desired.

Similar to control program 2, control program 3 uses a modular chapter based arrangement of lessons that include lab activities and opportunities for inquiry. Theses inquiry activities include chapter projects, discovery and exploration activities, activities that reinforce key concepts, inquiry skills practice and at home lab activities. The program emphasizes interdisciplinary exploration and the integration of other academic subjects. Each lesson includes an introduction to key lesson topics, engaging introductory activity, lab activities, reading guide, connections to other academic subjects, built in learning checks and review. The program also includes math practice activities and sections that emphasize Technology and Design. The program is a basal program with inquiry teaching approaches that

includes a variety of hands-on projects and activities to enhance inquiry.

Lessons in control program 4 are centered around a large scale class investigative activity which is followed by a typical textbook lesson. Unlike control program 1, control program 4 is organized in a modular chapter based arrangement. The program includes hands on investigative activities while integrating other academic subjects and cultural connections. The program includes engaging graphics and visual references that reinforce learning as well as integrated math skill and key concept activities. Each lesson includes an introduction to key lesson topics, reading guide, lab activities, highlighted vocabulary terms, connections to other academic subjects, and built in learning checks and review. As a basal program with inquiry elements, program 4 is similar to programs 2 and 3.

Control program 5 uses a more modular, chapter based arrangement of lessons that includes lab activities and built in self-assessments. Chapters open with a lesson preview and a hands-on lab activity to launch the lesson. The program emphasizes cross-curricular learning, lab activities and opportunities for review and assessment. Lessons are designed around critical thinking opportunities and real world applications. Each lesson includes an introduction to key topics and new vocabulary, reading checks, lab activities, math activities, science connections and section review. The program also includes Mini Lab activities that students can complete at home for further scientific exploration. Similar to control programs 2, 3, and 4, control program 5 is a basal program that blends in inquiry teaching approaches, including hands on projects and activities to encourage scientific inquiry.

In general, the content covered by the control programs were similar. Teachers participating in the study were instructed to cover topics as required by their respective state and districts, so there was variability in which science topics were covered by each grade in each school. For example, Chemistry was typically covered in 8th grade and Earth Science in 6th grade. The control curricula, including resources available, are described in more detail in Appendix D.

COMPARISONS BETWEEN PEARSON INTERACTIVE SCIENCE AND CONTROL PROGRAM CONTENT, COVERAGE AND PRACTICES

As a result of state and district scope and sequence guidelines prescribing what science content needed to be covered, treatment and control classes within schools generally taught similar content. While some topics were presented in a different sequence depending on the program used, for the most part the science concepts covered were comparable. Moreover, study teachers within each school generally noted that by the end of the year, the content covered in both treatment and control classrooms was similar.

As shown in Table 8, comparison on the percent of science topic areas completed during the school year showed that while treatment and control teachers covered approximately the same content areas, the amount covered varied. Only one significant difference was observed, with treatment teachers covering Science and Technology significantly more than control teachers, however given the limited sample size within certain topic areas (e.g., only two teachers covered Human Body Systems and Sound and Light) no additional significant differences were observed. Given observed differences in coverage, only topic areas that

matched[19] treatment and control teachers covered during the school year were included in the Developed Science Test, thus controlling for differences in content coverage.

Table 8. Percent Coverage of Science Topic Areas

	Control	PIS	# of classes covering topic area
1 - Science & Technology	36%	67%	19
2 - Earth's Structure	66%	78%	16
3 - Earth's Surface	63%	38%	8
4 - Water & Atmosphere	49%	51%	12
5 - Astronomy & Space Science	65%	62%	11
6 - Ecology & the Environment	37%	58%	17
7 - Cells & Heredity	37%	46%	11
8 - Diversity of Life	38%	50%	12
9 - Human Body Systems	15%	62%	2
10 - Intro to Chemistry	38%	50%	16
11 - Forces & Energy	28%	23%	12
12 - Sound and Light	80%	50%	2

It should be noted that not all topic areas were covered over the school year. On average, teachers covered 4 topic areas (range 1-7). This varied by grade level and school, with coverage based on district/state curriculum maps. As shown in Table 8, the topic areas taught in most classes included Science & Technology, Ecology and the

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[19] Specifically, teachers within the same grade level or teachers with a control and treatment class within the same school were matched and only topic areas covered by both teachers (or both types of classes) were included in the analysis of the Developed Science Test. This process helped control for differences in content coverage.

Environment, Earth's Structure, and Intro to Chemistry.

With respect to the textbooks and the pedagogical approaches employed by the various science curricula, there were notable differences between control and Pearson Interactive Science programs. As previously noted, all schools, except Schools B and C, used traditional, chapter-based, teacher delivered programs as their main control curricula. Schools B and C used an inquiry based program that was very hands on and allowed for student led inquiry. In comparison to the Pearson Interactive Science program, the basal control group materials used by schools did not incorporate technology to the degree that the Pearson Interactive Science program did. While four of the main control programs did have some digital resources, the teachers did not incorporate them into the main lesson, nor were they utilized by students for the practice, reference or differentiation activities they were designed for. The Pearson Interactive Science program also allowed students to fully access their interactive lessons and texts from home. In contrast, the control programs with digital resources allowed for general online access to lessons and chapters but were not interactive and it was not reported that students or teachers in control classrooms utilized these limited features.

When the pedagogy of the Pearson Interactive Science program is compared to the control programs there is a notable difference in the primary philosophy behind each program. Specifically, Pearson Interactive Science consistently delivers content and lessons driven by large, overarching concepts that span the gap between science concepts and real world applications; specific skills and activities support the larger concept. The inquiry

driven program (program 1) emphasizes critical thinking and problem solving skills. The Pearson Interactive Science program encourages students and teachers to begin each chapter by asking questions, whereas the control programs focus on a more traditional approach where students read text passages. The Interactive Write-In Student Edition used in the Pearson program also encourages students to be actively engaged with the Write-In Student Edition and the material as opposed to passively reading as in the control programs. While the skills and content is very similar between programs, the inherent differences stem from the way the Understanding by Design model asks students to look at the big picture first whereas the traditional pedagogy of the control programs attempt to move students from general concepts to a larger understanding. This, along with the blending of technology that is built into the Pearson Interactive Science program, are the greatest differences between this program and the control programs.

In terms of a typical lesson schedule, lessons in both control and treatment class were relatively consistent with a few exceptions as noted below. Lessons usually started with a bell ringer or warm up activity and a homework check. This was followed by a short investigative warm up activity or a review of the previous day's homework. Next teachers would introduce and begin the new lesson. Lessons included some lecture, discussion and reading. Depending on where they were in the chapter this was followed by a quick lab or full length lab investigation. Teachers would then assign book work or worksheet activities to be completed independently or in groups. Depending on the length of the class, students might have time to finish the majority of the assignment in class; if not it was generally sent as homework. At sites

where classes were shorter periods versus longer blocks, work was usually sent as homework.

In terms of specific instructional activities, there were some significant differences observed. While the teachers reported a similar flow in their lesson schedule, treatment teachers reported a significantly stronger emphasis in test taking skills, science review and inquiry skill concepts. Furthermore treatment students reported that they completed significantly more science labs and activities, tests and quizzes and used math when working on science problems more often than control students. Treatment students also reported that they were more likely to have worked from a science Write-In Student Edition in class, worked in groups and used SmartBoards or other technology to learn about science. Significant differences were also observed for control students who reported that they more often took notes, reviewed science assignments in class and recorded, represented and/or analyzed data than treatment students.

These were the only notable differences observed across schools in terms of science instruction. Appendix D contains a crosswalk between Pearson Interactive Science content and the control programs' content. As is clearly evident, there exists a close alignment. This is largely due to the educational community's demand on publishers to include content that is aligned to national and state standards and state assessments used for purposes of measuring annual yearly progress as required by NCLB.

FIDELITY OF IMPLEMENTATION

Three levels of implementation (low, moderate, and high) were assigned for teachers' implementation of key PIS program components as noted in the implementation guidelines (see Appendix D). Triangulation of the available information[20] showed that two teachers did not typically follow the implementation guidelines which outlined the key components of the Pearson Interactive Science program. In particular, these teachers did not complete the labs, show Untamed Science Videos, or have students Check Understanding with the requested frequency. These teachers noted that they did not have sufficient time to complete all activities while ensuring they covered necessary content prior to state assessments.

When the average implementation for each of the key components is examined, results show that teachers tended to implement the lab activities (Inquiry Warm-Ups, Quick Lab, and Lab Investigations) with less frequency than prescribed, therefore not engaging in these practices as outlined in the implementation guidelines. Indeed, the bulk of teachers who were classified as moderate implementers of the key program components failed to reach high implementation status because they did not complete labs with regularity (e.g., Inquiry and Quick Labs for each lesson). Teachers skipped labs, primarily following the first semester, in order to increase their pacing and coverage of required science topic areas. The Untamed Science Videos also were not shown with the requested frequency; while a couple of teachers reported that they lacked audio-visual equipment, most teachers who skipped these videos reported that the Untamed Science

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[20] Information was analyzed from teacher logs, class observations, and exit interviews.

videos took away from important instructional time. Thus, while the majority of study teachers did initially show these videos, given the limited amount of teaching time and the slow start in pacing as a result of teachers needing to get accustomed to the program, some teachers opted to skip them later in the school year.

Appendix E provides a more detailed table describing the extent to which teachers utilized the various PIS program components. Of note is that while most teachers did well in blending digital and print materials, two teachers never used the digital resources due to a lack of suitable technology infrastructure at their school and because they did not feel comfortable using the technology. For more information on how teachers implemented the Pearson Interactive Science program in their classrooms, see Appendix C: Case Studies.

Table 9. Level of PIS Implementation

Level of PIS Implementation	Completion of Key Program Components
High	80% or higher consistent completion of PIS components= **7 classes**
Moderate	60%-79% consistent completion of PIS components = **16 classes**
Low	Less than 60% of goals met = **5 classes**

Approximately 82% of classrooms were exposed to the key Pearson Middle Grades Science program components with a moderate to high level of fidelity.

No evidence of contamination was observed between teachers or in classrooms. That is, teachers did not use any components of the Pearson Interactive Science program with their control students. However, there was some movement of students from treatment to control classes (or vice versa) over the school year. These students were

excluded from the all program effect analyses that are subsequently reported.

It should be noted that the potential for contamination was given careful consideration when determining the level of random assignment. Through years of research experience, PRES researchers have found that the benefits of random assignment at the teacher/classroom level (hence, controlling for school and teacher level factors) with careful monitoring of possible contamination, outweighs the risk of contamination. Procedures used to eliminate the threat of contamination included an in-depth study orientation with teachers, site visits made to both treatment and control classrooms to observe what was occurring in classrooms, and monthly teacher logs that monitored practices and materials used across both treatment and control classrooms.

Overall, treatment teachers implemented the key Pearson Interactive Science program components with a moderate degree of fidelity. The components that most teachers did not implement with a high degree fidelity were the labs. While teachers were asked to complete a Quick Lab and Inquiry Warm-Up lab for each lesson and a Lab Investigation for each chapter, this did not always occur due to lack of time.

Results

This section is organized by the key questions from the RCT and reviews major findings first, followed by a more detailed presentation of results.

Major Findings

Does science ability improve as a result of participation in the Pearson Interactive Science program?

Results showed significant growth over the course of the school year as measured by the national, standardized TerraNova science test, and a developed science assessment aligned to the content covered during the school year and national standards. When tests for each content area in the TerraNova were examined separately, Pearson Interactive Science students' showed significant improvement in Earth Science, Life Science, and Scientific Inquiry performance.

Learning gains experienced by Pearson Interactive Science students can also be seen in the growth of percentile ranks on the norm-referenced TerraNova Science test. It is a general rule of thumb that if a student makes a year's growth for a year of instruction, then the percentile rank will remain the same. Over the course of the school year, the percentile ranking of Pearson Interactive Science students grew by 3.5% (57th to 60.5th percentile). The fact that the percentile rankings of students using Pearson Interactive Science increased during one school year suggests that growth in student learning occurred at a greater rate than would normally be expected relative to a national sample.

Do changes in science performance among Pearson Interactive Science students vary by different types of students and levels of implementation?

All subpopulations of students using Pearson Interactive Science showed significant learning gains in science on either one or both of the outcome assessments. That is, the Pearson Interactive Science program worked just as well with 6th, 7th, and 8th graders, females and males, White and non-White students, special education and non-special education students, English Language Learners and non-ELLs, students of varying science ability levels, and students receiving free/reduced lunch and those not receiving such assistance.

Analysis by implementation showed that Pearson Interactive Science students demonstrated significant learning gains, regardless of their teacher's level of implementation of the program.

Does using Pearson Interactive Science result in increased student achievement as compared to other types of science programs?

Results indicate that students using Pearson Interactive Science demonstrated significantly greater improvement in science as compared to students using other science programs. Specifically, Pearson Interactive Science students outperformed students using other science programs on the Developed Science test – a test aligned to the content taught in control and treatment classes as well as national standards. In addition, Pearson Interactive Science students had marginally significant higher test scores on the TerraNova science test as compared to control students.

Examination by subtests revealed that Pearson Interactive Science students showed higher levels of performance than control students on the Scientific Inquiry, Science & Technology and Life Science subtests of the TerraNova. Moreover, they outperformed students using other science programs on the multiple-choice items, which primarily measured science facts and concepts, and fill in the blank items, which primarily measure science vocabulary, of the Developed Science test.

The small to moderate effect sizes obtained in this study (d=.33 to .46) would be considered meaningful in the educational research literature. These effect sizes translate to Pearson Interactive Science students being 18 percentile points higher than control students on the Developed Science test, and 13 percentile points higher on the TerraNova science test.

Do effects on student science performance between Pearson Interactive Science and control students differ across types of students or control programs?

Results by student subgroups (i.e., grade, gender, minority status, free/reduced lunch, special education, English Language Learner, and science level) showed that there were no significant subgroup effects. This means that there was no difference between treatment and control students within these subgroups—both Pearson Interactive Science students and those using other science programs performed similarly at post-testing after controlling for pretest performance. In addition, no significant differences were observed for type of control program. It should be noted that the lack of significant differences may be due to the limited number of students within subgroups; therefore, sufficient power to

detect small to moderate effects was only present in the overall analyses.

Does participation in Pearson Interactive Science result in other positive outcomes (e.g., positive attitudes towards science, etc.)?

While the main focus of the Pearson Interactive Science program is to improve upon important science skills and understanding, other measures were included to explore if Pearson Interactive Science was associated with positive impacts on student and teacher attitudes, and classroom practices. Results showed that while the Pearson Interactive Science program produced positive effects on student learning, this did not always translate to positive changes in student and teacher attitudinal outcomes. For example, students using other science programs felt more strongly about their science abilities and enjoyed science more as compared to students using Pearson Interactive Science. Furthermore, control students indicated that their science programs prepared them to do well in state/national tests and future science courses to a greater extent than treatment students. Control teachers also generally had higher perceptions about their programs' assistance with differentiated instruction, progress monitoring, lesson preparation, and pacing as compared to treatment teachers.

That said, positive changes among Pearson Interactive Science teachers and students were observed in certain areas. For example, Pearson Interactive Science teachers reported being better prepared to teach various science content areas from Fall to Spring. In comparison to control teachers, Pearson Interactive Science teachers reported that they engaged in more activities designed to assist student's problem-solving skills and tended to

emphasize test taking skills, science review, and inquiry skill concepts to a greater extent than control teachers, though differences were not significant. Students using the Pearson Interactive Science felt that the Write-In Student Edition provided them with useful information to learn and understand science which was facilitated by the lab zones and visual representations. Teachers also noted that being able to write in the Write-In Student Editions helped with student engagement, learning, and a sense of pride in their work. Additionally, the vast majority of teachers and students felt that the Pearson Interactive Science program helped students make connections between science, real world applications, and other subject areas.

What did users of Pearson Interactive Science think about the program?

Approximately 87.5% of treatment teachers and 80% of treatment students reported enjoying the Pearson Interactive Science program. The majority of teachers and students also reported that they would like to use the program during the following school year. Students and teachers felt the program was easy to understand, engaging and well-organized. Furthermore, when treatment teachers and students were asked to compare the Pearson Interactive Science program to their prior year's science program on various aspects (e.g., overall quality, labs, resources, organization, etc.), teachers and students generally rated the Pearson Interactive Science program as better than their prior program.

Teachers noted a variety of specific program components when asked to identify the three things they liked best about the Pearson Interactive Science program. However, a few items emerged as favorites from many teachers, including:

- Write-In Student Edition
- Lab Activities
- Online Digital Path

Teachers reported that they really liked the Write-In Student Edition in that students could write in them and actively participate and interact with the text. Teachers also mentioned that they liked the student ownership aspect of the consumable Write-In Student Edition. Despite some critiques regarding the lab activities (e.g., some take too much time to complete and set up, are not meaningful, etc.) most of the teachers indicated that they liked the variety of labs available as well as the lab materials that were provided with the program. As well, a majority of teachers reported that they liked the Online Digital Path especially the ability to edit worksheets, labs and tests/quizzes.

Detailed Findings

Does science ability improve as a result of participation in the Pearson Interactive Science program?

In order to determine whether students who used Pearson Interactive Science showed significant learning gains over the course of a school year, analysis on outcomes were conducted via paired sample t-tests. Results showed significant growth in science performance on both the *TerraNova* and Developed Science assessments, $p<.05$. It should be noted that the *TerraNova* measures a variety of science content areas (Physical, Earth, Life, Science and Technology, and Scientific Inquiry), which rarely were all covered by study classes. Because of this, the *TerraNova* overall scale score is not as sensitive as the Developed Science test which was aligned to the content covered by treatment and control study classes. With this in mind, results indicate that across all grade levels students showed significant growth from pre to post testing on both assessments. Moreover, the percentile rank gain of 3.5% is noteworthy -- it is a general rule of thumb that if a student makes a year's growth for a year of instruction, then the percentile rank will remain the same.

Figure 3. Pre- and Post TerraNova Science Performance of Pearson Interactive Science Students
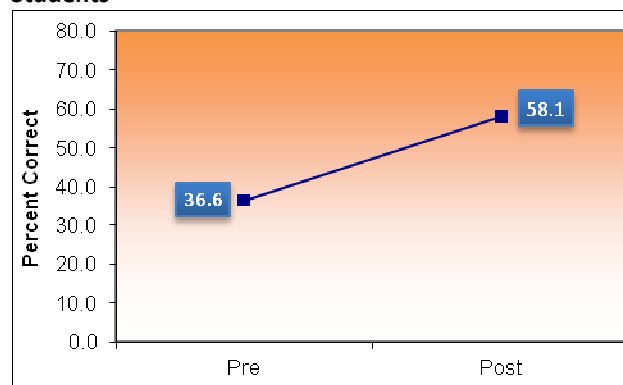
Figure 4. Pre- and Post Developed Science Test Performance of Pearson Interactive Science Students
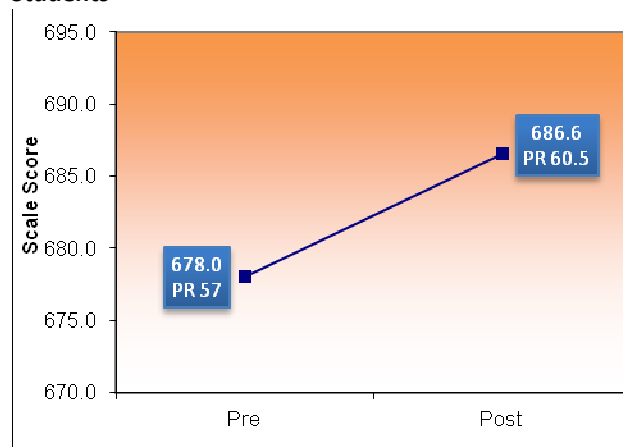
Students who used Pearson Interactive Science showed significant growth in science performance as measured by the standardized TerraNova Science test and a developed science assessment aligned to the science content covered during the school year as well as national standards. In addition, the percentile rank gain of 3.5% is noteworthy as it's more than would be expected in a typical school year.

In order to more closely examine the relationship between *TerraNova* student science performance and the Pearson Interactive Science program, analyses were conducted such that only classes that covered topics within each content area (Physical, Earth, Life, Science and Technology, and Scientific Inquiry) were included in analyses. Results showed that Pearson Interactive Science students made significant learning gains in each of the content areas, with the exception of Science and Technology, see Figures 5-9. As shown, students showed the greatest gains in the areas of Earth (5.2% gain), Life Science (5.0% gain) and Scientific Inquiry (4.2% gain). Students also made significant gains in Physical Science (3.1% gain), but not in the area of Science and Technology (2.9% gain).

Figure 5. Pre- and Post TerraNova Earth Science Performance of Pearson Interactive Science Students

Figure 6. Pre- and Post TerraNova Life Science Performance of Pearson Interactive Science Students

Figure 7. Pre- and Post TerraNova Physical Science Performance of Pearson Interactive Science Students

Figure 8. Pre- and Post TerraNova Scientific Inquiry Performance of Pearson Interactive Science Students

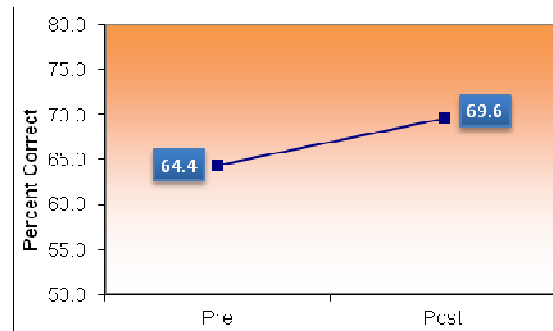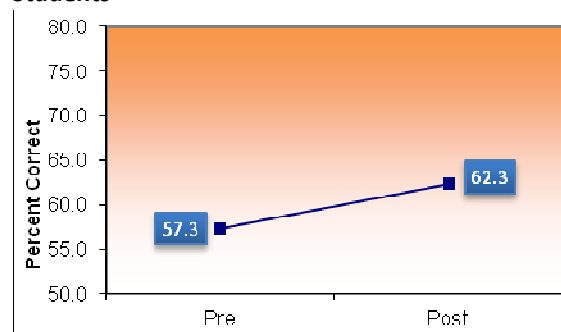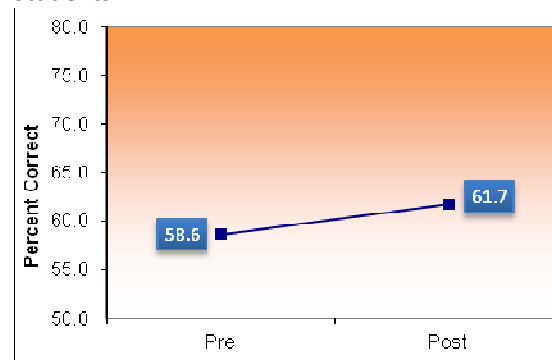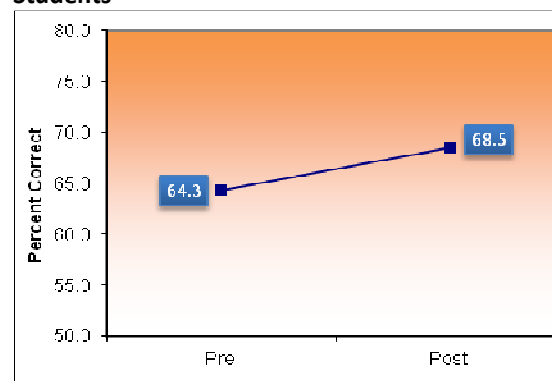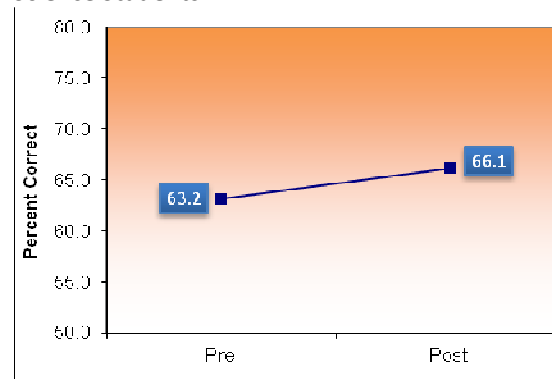**Figure 9. Pre- and Post TerraNova Science and Technology Performance of Pearson Interactive Science Students**

When tests for each content area were examined separately, results showed significant growth in Earth Science, Life Science, Physical Science, and

Scientific Inquiry performance. Significant growth was not observed on the Science & Technology subtest.

Do changes in science performance among Pearson Interactive Science students vary by different types of students and levels of implementation?

In order to examine whether the Pearson Interactive Science program was associated with improvements among students of various subgroups, exploratory, descriptive analyses were conducted. Only the performance of *treatment* students in specific student populations (i.e. students receiving free/reduced lunch and students not receiving aid, males and females, minority and non-minority students, English Language Learners and non-ELLs, special education students and students not in special education, students of various science levels and students of various grade levels) was examined in these analyses. It should be noted that the sample sizes in some of the subgroups are small and there are unequal sample sizes between those in the special populations and those not for a number of variables[21]. Therefore, with the caveat that these analyses are limited, this provides readers with preliminary, descriptive information on whether the program is associated with improvements among various subgroups. Figures 10 through 21 display the results for the various subgroups.

Results showed that all subpopulations of students using Pearson Interactive Science showed significant learning gains in science on either one or both of the outcome assessments. That is, generally females and

males, minorities and non-minorities, students receiving free/reduced lunch and those not, ELLs and non-ELLs, students in special education and those not, and students of various science levels and grades showed significant learning gains, $p<.05$.

In addition, differential growth rates were observed for the following subgroups: grade, minority status, special education status, and science level. Specifically, on the *TerraNova* Science test, 7th graders showed the greatest gains followed by 6th graders and 8th graders. On the Developed Science test, 7th graders also showed the highest gains, but they were followed by 8th graders and then 6th graders. Non-minority students who used the Pearson Interactive Science program showed greater gains than minority students on the *TerraNova* Science test. Students not in special education showed higher levels of performance than special education students as measured by the Developed Science test. In addition, on the *TerraNova* Science test, low performing science students showed the greatest gains, followed by average level students and high level students. Interestingly, the opposite pattern was observed on the Developed Science test, with high performing students showing the greatest gains, followed by average and low performing students.

In general, females and males, students of various ethnic/racial backgrounds, students receiving free/reduced lunch and those not, ELLs and non-ELLs, special education students and students not in special education, and students of various science levels and grades showed significant learning gains from pre- to post-testing.

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[21] The reader is referred to the Technical Report for detailed statistics.

Figure 10. PIS Students Performance Gains by Grade Level: TerraNova
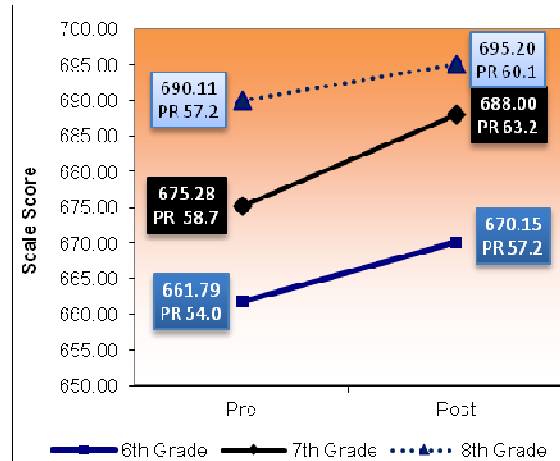
Pearson Interactive Science students at all grade levels showed significant growth on the TerraNova Science test. In addition, 7th grade students showed the largest amount of learning gains.

Figure 11. PIS Students Performance Gains by Grade Level: Developed Science Test
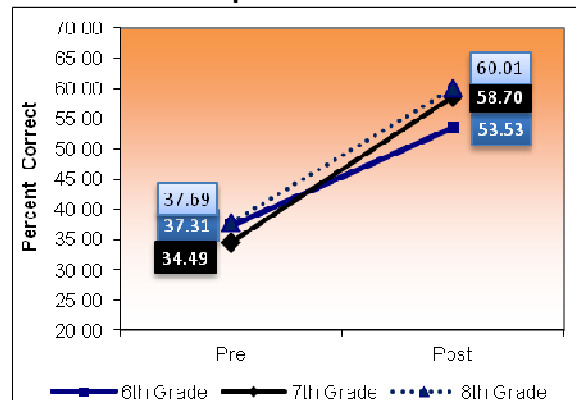
Similarly, Pearson Interactive Science students of all grade levels showed significant learning gains on the Developed Science test. Again, 7th grade students showed the greatest level of improvement from pre- to post-testing.

Figure 12. PIS Students Performance Gains by Minority Status: TerraNova

Non-minority Pearson Interactive Science students showed significant improvement on the TerraNova Science test, whereas minority students did not. Results also showed that non-minority students had greater gains as compared to minority students.

Figure 13. PIS Students Performance Gains by Minority Status: Developed Science Test
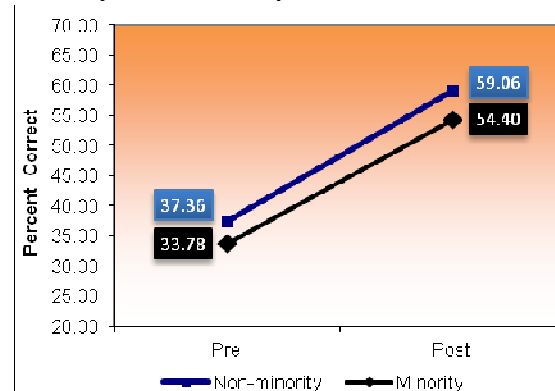
Pearson Interactive Science minority and non-minority students showed similar levels of improvement on the Developed Science test.

Figure 14. PIS Students Performance Gains by Gender: TerraNova
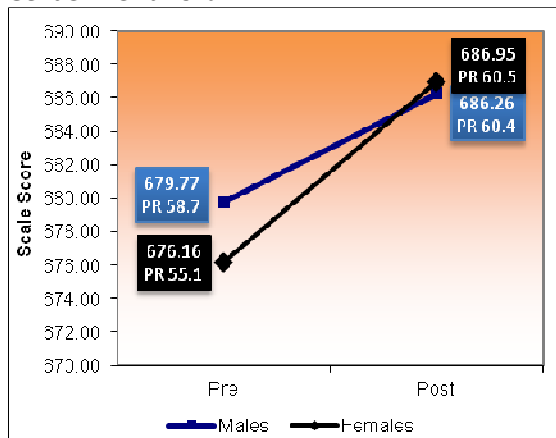
Both female and male Pearson Interactive Science students showed significant improvement on the TerraNova Science test.

Figure 15. PIS Students Performance Gains by Gender: Developed Science Test
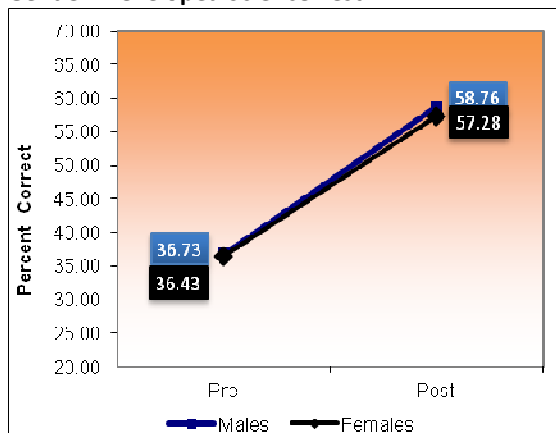
Females and males also showed significant, similar learning gains on the Developed Science test.

Figure 16. PIS Students Performance Gains by Special Education Status: TerraNova

Both special education and non-special education students who used Pearson Interactive Science showed significant learning gains over time on the TerraNova Science test.

Figure 17. PIS Students Performance Gains by Special Education Status: Developed Science Test
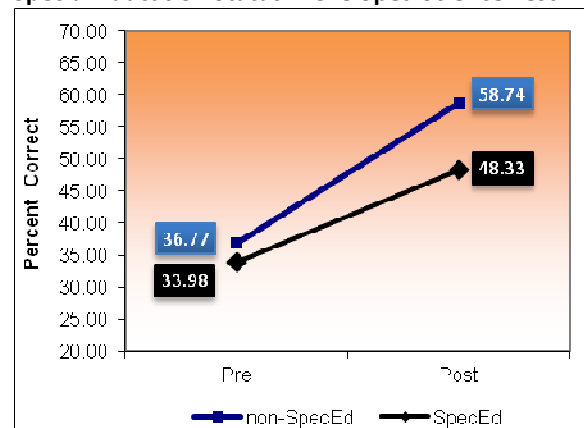
Special education and non-special education students also showed significant improvement on the Developed Science test. In addition, results showed that students not in special education had greater gains than special education students.

Figure 18. PIS Students Performance Gains by Free/Reduced Lunch Status: TerraNova
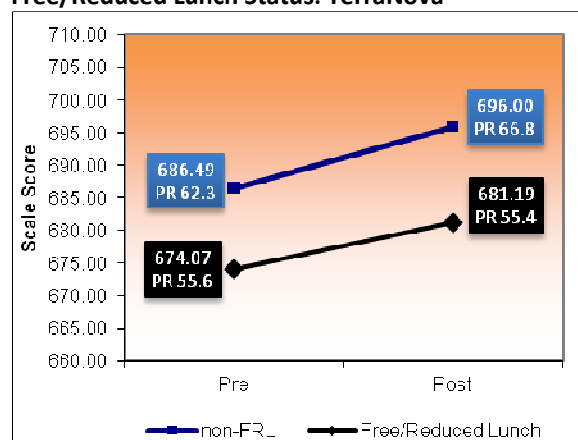
Three schools reported data on the free/reduced lunch status of their participating students. Among these schools, results showed that Pearson Interactive Science students not receiving free/reduced lunch had significant gains on the TerraNova Science test. In contrast, students receiving free/reduced lunch did not show significant improvement.

Figure 19. Figure 6. PIS Students Performance Gains by Free/Reduced Lunch Status: Developed Science Test
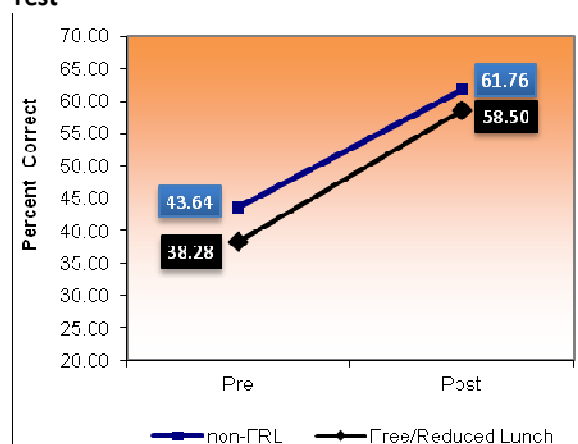
Pearson Interactive Science students receiving free/reduced lunch and those not receiving this assistance showed significant improvement on the Developed Science test.

Figure 20. PIS Students Performance Gains by English Language Learner Status: TerraNova
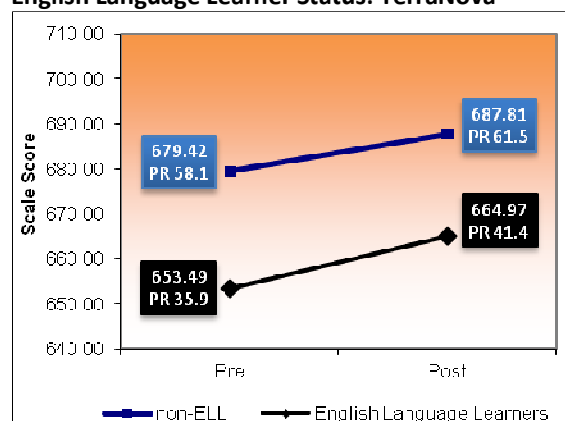
Both English Language Learners and non-ELLs who used Pearson Interactive Science showed significant gains in science performance as measured by the TerraNova Science test.

Figure 21. Figure 6. PIS Students Performance Gains by English Language Learner Status: Developed Science Test
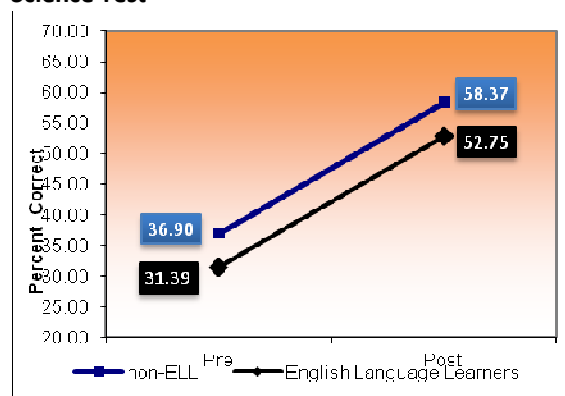
Similarly, English Language Learners and non-ELLs showed significant science improvement on the Developed Science test.

SCIENCE LEVELS

Performance results from the *TerraNova* Science test administered in the Fall were used to categorize students on initial science level, since it is a norm-referenced test. Students who were at or below the 33rd percentile were classified at a low science level, students who were at or above the 66th percentile were classified as high, and the remaining students were classified as average. Comparisons were made between the three identified science levels. As previously noted, students at all science levels showed significant growth on the Developed Science test. However, on the *TerraNova* Science test, students who were at the low and average level showed significant improvements. High level students did not. That said, this may be the result of a ceiling effect (that is, there is less room for growth at the high level).

Figure 22. PIS Students Performance Gains by Science Level: TerraNova
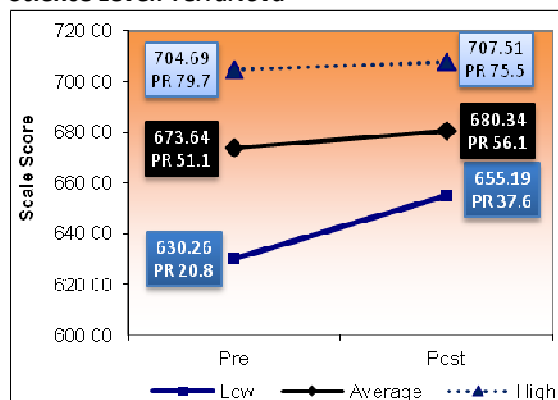
Low and average level Pearson Interactive Science students showed greater growth than high level students on the TerraNova. Indeed, high level students did not demonstrate significant growth. However, this may be due to a ceiling effect such that there is limited room for growth among high performers.

Figure 23. PIS Students Performance Gains by Science Level: Developed Science Test
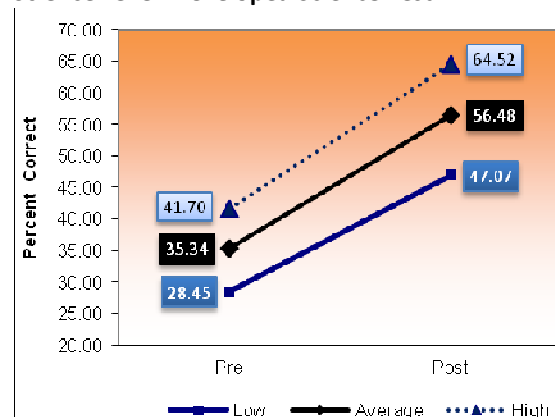
While Pearson Interactive Science students of all ability levels showed significant improvement over time on the Developed Science test, high and average level students tended to show greater growth than low level science students.

IMPLEMENTATION LEVELS

In addition to these analyses among subgroups of Pearson Interactive Science students, exploratory analyses on the relationship between overall levels of PIS implementation of key program components and student science performance were conducted. These analyses provide preliminary information on whether low to high implementation fidelity of PIS[22] components was associated with student performance. Note that sample sizes are uneven, with the majority of treatment teachers being moderate implementers.

Results showed no significant relationship between overall PIS implementation levels and improved performance on the *TerraNova* and Developed Science assessments, $p > .05$. This means that students whose teachers used the Pearson Interactive Science program with high fidelity showed the same level of gains

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[22] See section on Fidelity of Implementation for how this categorization was determined.

in science as teachers who used the program with average and low levels of fidelity, see Figures 24-25.

Figure 24. PIS Students Performance Gains by Implementation Level: TerraNova

Figure 25. PIS Students Performance Gains by Implementation Level: Developed Science Test
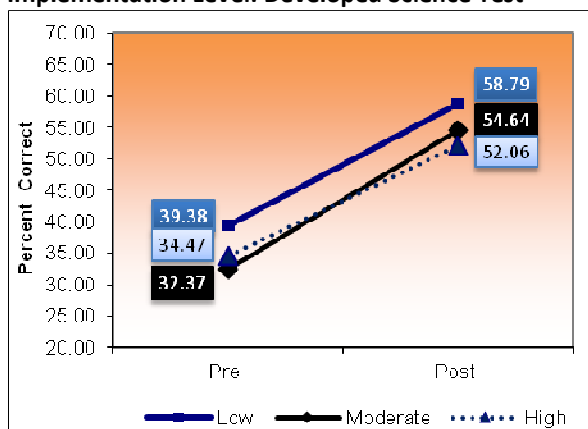
Preliminary analyses showed that Pearson Interactive Science students demonstrated significant learning gains, regardless of their teacher's level of implementation of the program.

The aforementioned analyses focused on the extent to which Pearson Interactive Science is positively associated with student science performance. Results clearly show significant improvements among students overall, and among subgroups of students. However, these analyses do not examine how Pearson Interactive Science students compared to students using other science programs. The following section presents analyses of how the science performance of students taught via Pearson Interactive Science compares to the performance of students using other science programs.

Does using the Pearson Interactive Science program result in increased student achievement as compared to other types of science programs?

Prior to discussing the results found, it is important to understand the differences and similarities of the Pearson Interactive Science program and control curricula and classes. This will assist the reader in interpreting the results and effect sizes[23], a measure of the importance of an intervention.

COMPARISON OF PEARSON INTERACTIVE SCIENCE AND CONTROL CLASSES

As previously noted, control and treatment classes generally were exposed to the same content within schools. This is due to teachers following curriculum pacing guides that dictate what content to cover at each grade level. While coverage was fairly homogenous within schools, across all study schools there was variation in the extent to which control and treatment teachers covered specific topic areas. For instance, treatment teachers covered Science and Technology significantly more than control teachers, and while not statistically significant, there was also variation in coverage of Human Body Systems (treatment teachers covered more) and Sound and Light (control teachers covered more). Given observed differences in coverage, only topic areas that *matched* treatment and control teachers covered during the school year were included in the Developed Science Test, thus controlling for differences in content coverage.

In addition, differences existed with respect to the pedagogy employed. With the exception of control program 1, the control programs were structured in a more traditional way while the premise of the Pearson Interactive Science program is based on Understanding by Design and the associated focus on Big Ideas, Enduring Understandings, and 5Es, along with an emphasis on critical thinking and inquiry skills. Control program 1, in contrast, focuses exclusively on an investigative approach, with lessons organized around lab investigations. Furthermore, the Pearson Interactive Science program integrated technology to a much larger degree than control programs. For example, treatment classes had greater access to their science programs and additional assistance and practice outside the classroom through online resources.

Although differences were noted, similarities between the control and treatment programs were also evident. With the exception of Schools B and C who used control program 1, the control and PIS programs included cross-curricular learning, daily practice exercises to reinforce concepts taught during the lesson, science vocabulary, and built in learning checks and review. Furthermore, all programs included a number of lab activities (from quick labs to more extensive investigations) and implementation of hands-on labs among teachers did not significantly vary. Assessment and independent practice also was fairly constant between groups.

There were also no notable differences between the groups in terms of how the lessons were structured or delivered. While teaching styles varied for some teachers, the instructional sequence and practices employed was comparable across treatment and control classes, and from teacher to

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[23] Effect size (ES) is commonly used as a measure of the magnitude of an effect of an intervention relative to a comparison group. It provides a measure of the relative position of one group to another. For example, with a moderate effect size of d=.5, we expect that about 69% of cases in Group 2 are above the mean of Group 1, whereas for a small effect of d=.2 this figure would be 58% and for a large effect of d=.8 this would be 79%.

teacher. Generally lessons included bell work and a review of the previous day's homework or prior lesson. Depending on the day, this was followed with whole group instruction of the new concept or a lab activity. If time remained, the last part of the class typically involved independent practice.

In summary, Pearson Interactive Science and control classrooms, with the exception of the program-based activities and coverage of certain topic areas, were similar to one another in terms of structure and science concepts. Given this information, and the fact that the duration of the study and exposure to the program occurred during *one* school year, small effect sizes were expected. After all, even with training provided, there is a learning curve for teachers in their first year of implementing a new program. Indeed, it is recommended that *cumulative* student exposure be examined to determine the sustainability of effects observed. However, due to practical and fiscal limitations, this study was done in only one school year. It should also be noted that according to Slavin (1986), a leader in educational research, an effect size of .25 is considered educationally significant.

RESULTS

Multilevel modeling was conducted to examine whether there were significant differences in: 1) student post-test performance after controlling for pretest performance; and 2) growth of science skills between treatment and control students. The former analyses were conducted due to the significant differences between treatment and control groups during pretesting; the two level models directly control for pretest differences along with other covariates in

which groups differed[24], thus equating groups. In contrast, the three level models examines *changes* in outcomes between the pre and post-testing.

What follows is a summary of results based on both types of models. Results from the two and three level models generally agreed with one another in that observed differences were significant under both models: 1) when directly controlling for the pretest; and 2) when examining differences in growth from pre to post-testing. That said, dissimilar findings are pointed out as well. To simplify presentation of findings, the graphs presented are based on the two level models[25].

Results showed a significant difference between students who used the Pearson Interactive Science program and students using other science programs on the Developed Science test, after controlling for pretest performance, $p<.05$. In addition, a marginally significant difference was observed on the overall *TerraNova* Science test, after controlling for pretest differences, $p<.10$. In both cases, PIS students outperformed control students—thus a positive impact was observed, see Figures 26-27. In addition, results from growth models showed significant gains on the Developed Science test, $p<.05$, and a marginally significant gain on the *TerraNova* Science test, $p<.10$, between students who used Pearson Interactive Science students and students who used other science programs. Thus, PIS students showed accelerated learning gains on the

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[24] Covariates for both two and three level models include pretest, grade level, student science anxiety (aggregated to group level), student perception of teacher support (aggregated to group level), and school.
[25] The two level models are more sensitive in modeling differences as it directly controls for pretests. Detailed information and statistics regarding results from both models are presented in the accompanying Technical Report.

science assessments as compared to control students.

Figure 26. Developed Science Posttest Performance of PIS and Control Students
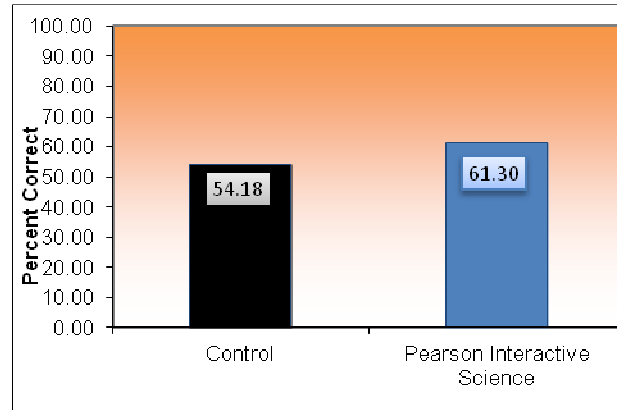
Figure 27. TerraNova Science Posttest Performance of PIS and Control Students
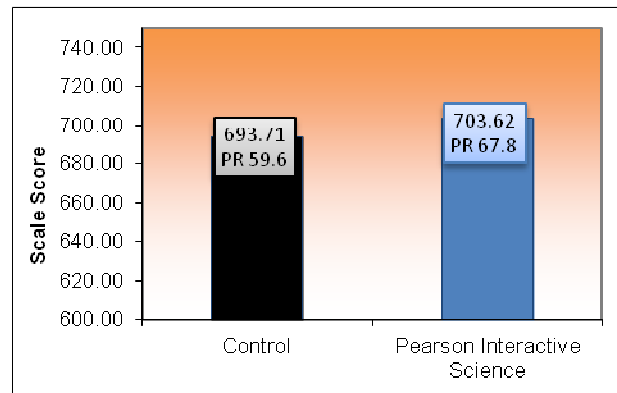
Results showed that Pearson Interactive Science students outperformed students using other science programs on the Developed Science Test – a test aligned to the content taught in control and treatment classes. In addition, Pearson Interactive Science students had marginally significant higher test scores on the TerraNova Science test as compared to students using other science programs.

When tests for each *TerraNova* science content area were examined separately, results showed that when pretest performance was controlled for, significant differences were observed on the posttest for Scientific Inquiry and Science & Technology, $_{p<.05}$, see Figure 28. In addition, Pearson Interactive Science students had significantly greater learning gains from pre- to post-testing on Scientific Inquiry and Life Science as compared to students using other science programs, $_{p<.05}$. Results for Life Science are presented in Figure 29. Note that the consistency in findings for the Scientific Inquiry subtest indicates that PIS students outperformed control students in their ability to interpret data and their understanding of scientific methods and design.

Figure 28. TerraNova Subtest Post Performance of PIS and Control Students: Scientific Inquiry and Science & Technology
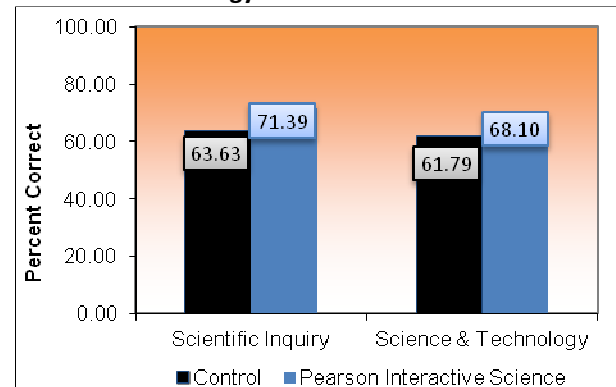
Figure 29. TerraNova Life Science Pre-Post Performance of PIS and Control Students
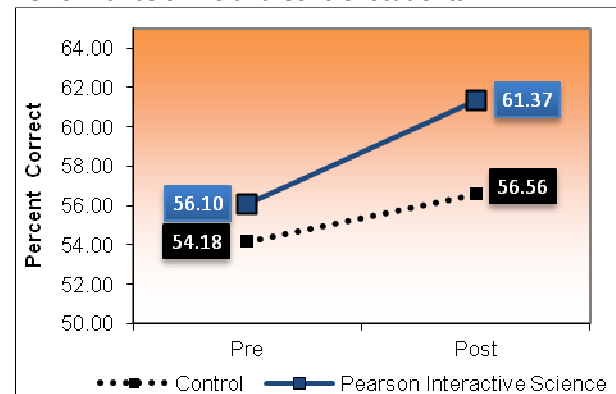
Pearson Interactive Science students showed higher performance on the TerraNova Scientific Inquiry and Science & Technology subtests than students using other science programs, after controlling for pretest differences. In addition, treatment students demonstrated greater improvement on the Scientific Inquiry and Life Science test as compared to control students.

Figure 30. Developed Science Posttest Performance of PIS and Control Students: By Test Items


In order to explore if there were differences among treatment and control students with respect to their performance on different types of test items, further analyses of the Developed Science test were conducted. As a reminder, this assessment included three types of test items: 1) multiple-choice items primarily measuring science facts and concepts; 2) fill in the blank items primarily measuring science vocabulary; and 3) short answer items primarily measuring scientific reasoning skills and application of science concepts.

Results controlling for pretest differences showed that PIS students outperformed control students on both multiple-choice and fill in the blank posttest items, $_{p>.05}$. Moreover, PIS students had significantly greater growth from pre to post-testing as compared to students using other science programs as measured by these types of test items, $_{p>.05}$. The consistency in results for these two types of test items suggests that students using Pearson Interactive Science have a greater knowledge and understanding of science facts/concepts and vocabulary as compared to students using other science programs.

Students using the Pearson Interactive Science program performed better on the multiple-choice items (measuring science facts/concepts) and fill in the blank test items (measuring science vocabulary), as compared to students using other science programs.

EFFECT SIZES

Effect size is a commonly used measure of the importance of the effect of an intervention (in this case, Pearson Interactive Science). All effect sizes were positive indicating a favorable effect of the Pearson Interactive Science program on student science performance. In addition, the effect sizes obtained can be classified as small-moderate (d=.33 for *TerraNova* and d=.46 for Developed Science Test), and exceed the threshold (.25) for educational significance. This means that the findings are meaningful in terms of impacting a students' educational experience.

In order to better understand the effects observed as a result of exposure to the Pearson Interactive Science program, effect sizes can be translated to the percent of treatment students that can be expected to be

above the average of the control group (see blue part of bar in Figure 31). As shown, students using Pearson Interactive Science are more likely to have scored above the average of control students.

Figure 31. Percent of PIS Students Above and Below Average Relative to Control Students: TerraNova and Developed Science Tests
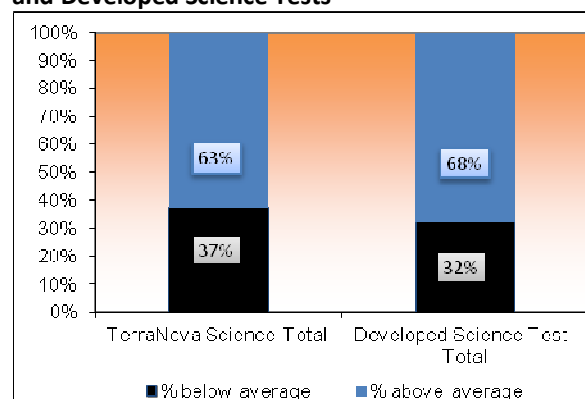
Results show that 63% and 68% of Pearson Interactive Science students scored above the average control student as measured by the TerraNova and Developed Science tests respectively. In other words, PIS students were 18 percentile points higher than the average of control students on the Developed Science Test, and were 13 percentile points higher on the TerraNova Science Test than control students.

Figure 32 shows the percent of Pearson Interactive Science students that can be expected to score higher than control students for each of the subtests in which a significant effect was observed, after controlling for pretest differences[26].

Figure 32. Percent of PIS Students Above and Below Average Relative to Control Students: Science Subtests

TN= *TerraNova*; DST=Developed Science Test
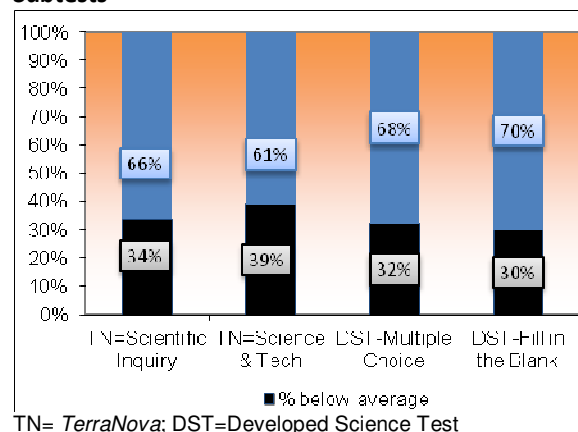
On the subtests, Pearson Interactive Science students were 11 to 20 percentile points higher as compared to the average of control students.

It should be noted that the WWC calculates an improvement index which represents the difference between the percentile rank of the average student in the intervention condition (i.e., PIS) and that of the average student in the comparison condition. The improvement index can take on values between –50 and +50, with positive numbers denoting favorable results. Using the aforementioned effect sizes[27], the improvement index for this study can be calculated to be approximately +15.5, a noteworthy figure.

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[26] This is based on two-level models.

[27] The domain average improvement index for each study is computed based on the domain average effect size for that study rather than as the average of the improvement indices for individual findings within that study. In the case of the present study, the improvement index was calculated for the TerraNova and Developed Science tests (averaged).

Do effects on student science performance between Pearson Interactive Science and control students differ across types of students and control programs?

To examine if there were differences in performance between different subgroups of Pearson Interactive Science students and students using other science programs, subgroup effects were analyzed. Specifically, differences between PIS and control students in the following subgroups were examined: grade, gender, minority status, free/reduced lunch status, special education status, English Language Learner status, science ability level, and type of control program. As previously noted, multilevel models account for statistical issues that can affect the validity of the results. Furthermore, it is important to view these analyses as exploratory[28].

Results by student subgroups (i.e., grade, gender, minority status, free/reduced lunch, special education, English Language Learner, and science level) showed that there were no significant subgroup effects. This means that there was no difference between treatment and control students within these subgroups—both Pearson Interactive Science students and those using other science programs performed similarly at post-testing after controlling for pretest performance. In addition, no significant differences were observed for type of control program. It should be noted that the lack of significant differences may be due to the limited number of students within subgroups.

Analysis conducted to examine if there were differences between Pearson Interactive Science students and control students in specific subgroups (i.e., grade, gender, minority status, free/reduced lunch, special education, English Language Learner, science level, type of control program) showed that both Pearson Interactive Science students and control students within subgroups performed similarly at post-testing after controlling for pretest performance.

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[28] Detailed information on why this is exploratory and non-causal and statistics, as well as these results are presented in the accompanying Technical Report.

Does participation in Pearson Interactive Science result in other positive student outcomes (e.g., positive attitudes towards science and so forth)?

While the primary focus of the Pearson Interactive Science program is to improve students' science understanding and skills, the program incorporates a number of program components that may have an effect on other important aspects of science education, including affective attitudes. Measures were included in the RCT to explore whether use of the PIS program was associated with changes in student attitudes towards science as well as changes in teacher practices and attitudes.

STUDENT ATTITUDES TOWARD SCIENCE

Comparison of data collected on science-related student attitudes showed a significant effect for perceived science ability, $p<.05$, and enjoyment of science, $p<.05$.

Specifically, control students were more likely to agree that they were good in science and that they enjoyed science, as measured by the Spring 2011 student survey, see Figure 33. No significant differences were observed for the importance/usefulness of science, their effort/motivation in science, or educational aspirations.

In the following sections, more detailed information is presented on how the science programs impacted students in terms of: 1) science learning, 2) engagement and motivation, 3) reading/writing skills, 4) application of science, and 5) preparation for future tests and science courses.

> **_Results showed that students using other science programs felt more strongly about their science abilities and enjoyed science more as compared to students using Pearson Interactive Science._**

Figure 33. Student Science-Related Attitudes* by Group
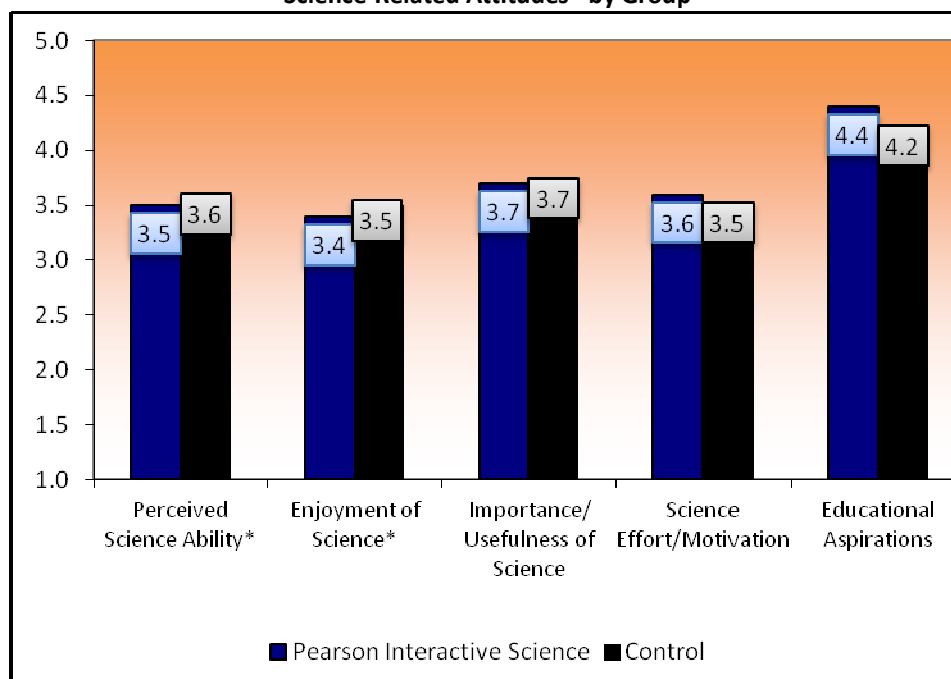
Higher scores indicate more positive attitudes. Based on scale of 1-5.

Results showing improvement on the custom assessment and *TerraNova* are also supported by information from the student surveys. When asked to compare their prior science program to the Pearson Interactive Science program, students felt that the PIS program was more effective in helping them learn science, see Figure 34.

Figure 34. Student Perceptions of the Degree to Which the Pearson Interactive Science Program Helped Them to Learn Science
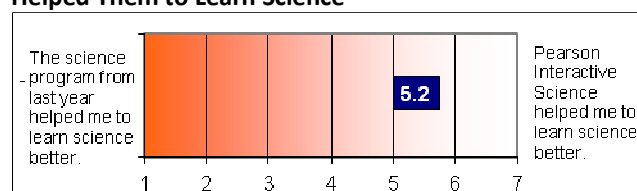
♦ *The old book, I barely read. It was way too boring and lifeless. The Pearson Interactive Science book, however, helped me to understand the topic and learn more. – Student*

♦ *It [Pearson Interactive Science] was highly organized, and easy to learn. It explained things very well, and made taking notes much simpler. – Student*

As shown in Figure 35, the majority of students (89%) reported that the Pearson Interactive Science Write-In Student Edition provided them with useful information to learn and understand science. Furthermore the vast majority of students (over 90%) also reported that they learned a lot in science class while using the new Pearson Interactive Science program. Students noted that learning was facilitated by the organization and interactive components of the program including the lab activities (83%), diagrams and visual representations (87%), and short assessments including in the Write-In Student Edition (81%).

Moreover, the majority of teachers (94%) also reported that the diagrams and visuals within the Write-In Student Edition were useful to students learning. In sum, students felt that in comparison to their prior science program, the Pearson Interactive Science program helped them learn about science and this was due to key features of the program.

Figure 35. Percent of Students who Agreed the Pearson Interactive Science Program Helped Them Learn Science
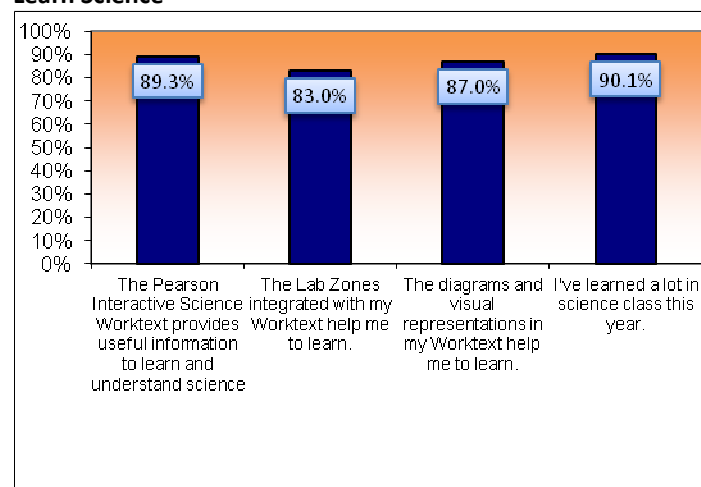
Students using the Pearson Interactive Science felt that the Write-In Student Edition provided them with useful information to learn and understand science which was facilitated by the lab zones and visual representations.

♦ *For me, it's easier to learn the science concepts when I have to answer questions and interact. The Pearson program does this. – Student*

♦ *I think the Pearson Interactive Science helped me because it has a lot of questions you can answer, study guide, and good reading content.– Student*

- *Pearson Interactive Science had a more descriptive definition on the subject and how it shows pictures and diagrams to dissect each individual lesson in science. This really helped. – Student*

- *I thought they learned more with this program, definitely I went into more depth or they went into more depth then if I had been doing teacher centered lessons, they probably learned more. - Teacher, Site NY*

STUDENT ENGAGEMENT AND MOTIVATION

In general, Pearson Interactive Students reported that they were engaged in science while using the Pearson Interactive Science program. Treatment students commented that interactive aspects of the book along with the integrated lab activities were engaging. Students also liked the interactive pictures and diagrams noting that it helped them feel more involved in learning science. In general, the majority of Pearson Science Interactive students looked forward to science class as well.

Figure 36. PIS Student Perceptions of the Degree to Which They Were Engaged in Science
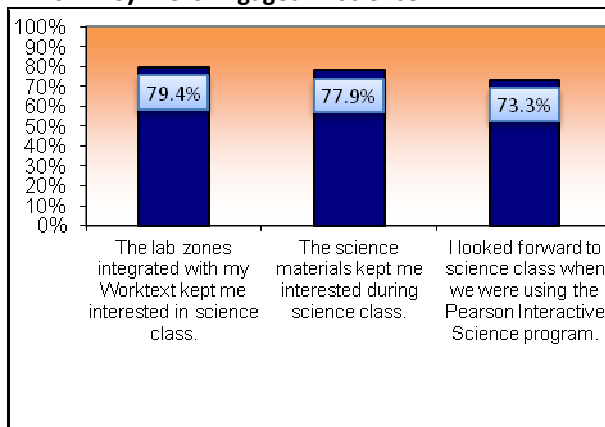
- *The science program [Pearson Interactive Science] was more fun and interesting this year and they helped me learn better. – Student*

- *I like Pearson Science because we did physically, like doing labs instead of just talking about it like we did last year, I like Interactive Science better. – Student*

- *[Pearson Interactive Science] was not just boring words on a page - I was doing activities also which helped me learn and pay attention more. – Student*

- *The Pearson Interactive Science textbooks are interesting and fun to use, and full of fun facts. – Student*

Pearson Interactive Science students looked forward to science and felt that the integrated lab activities and science materials helped them feel engaged in science.

As shown in Figure 37, comparisons between treatment and control students showed that, while control students felt that they more actively participated in learning about science during the school year, students using the Pearson Interactive Science program felt that the content presented in their program kept them interested in science, $p<.05$. In addition, although not statistically significant, Pearson Interactive Science students also agreed more that the questions/problems in their texts were interesting and that the activities from their program were fun.

Figure 37. Student Perceptions of the Degree to Which They Were Engaged in Science: PIS and Control Students
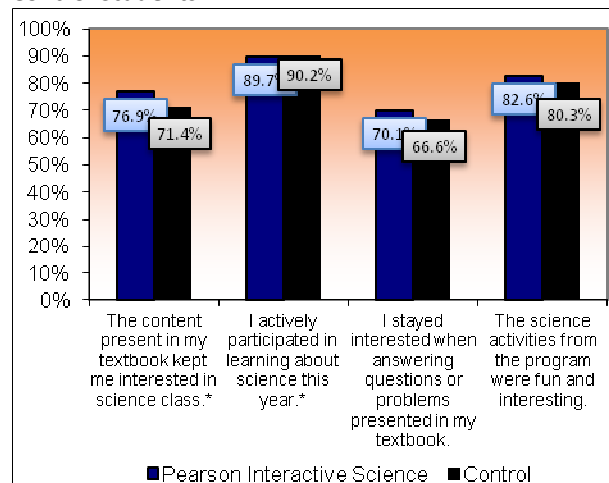
*p<.05

In comparison to control students, Pearson Interactive Science students felt that their program's content kept them more interested in science. In contrast, control students reported more active participation in their science learning.

When teachers were asked about their students' interest and enjoyment of science, results showed no significant differences. As shown in Figure 38, treatment and control teachers were comparable in terms of how engaging the science activities and labs were for their students. It is interesting to note that the majority of treatment teachers agreed with their students in that the questions/problems within the Write-In Student Edition were engaging. In particular, both students and teachers indicated that the ability to write in the Student Edition helped students feel more involved in their learning. The writing and drawing activities also helped to reinforce the content being taught and to apply their knowledge. Moreover, they felt that writing in their Student Edition helped instill a sense of ownership and pride in their work.

Indeed, 94% of treatment teachers felt that students took pride in their work.

Figure 38. Perceptions of the Degree to Which They Were Engaged in Science: PIS and Control Teachers
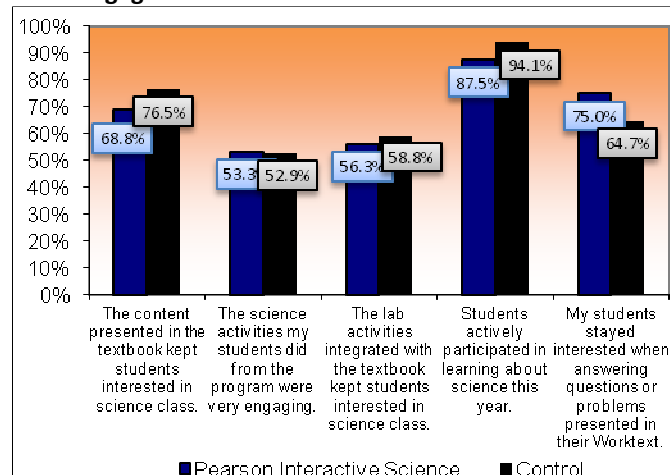
- *The kids were little sponges and when you were going over it they were just sucking it up; I loved it, I would go on the road selling this program. I just can't say enough good about it. - Teacher, Site KY*

- *I absolutely think the kids were more engaged in the class when having to interact with the book [PIS]. The information is current and relevant. –Teacher, Site PA*

- *I really liked that we could write in the book (take notes/answer questions). The book is ours now to keep and made me interested in science. – Student*

- *I loved how we could write in the book. The book itself is interactive, interesting, and answers the Big questions. – Student*

While treatment and control teachers felt that their students level of engagement was not significantly different, the majority of teachers and students using the Pearson Interactive Science program reported that being able to write in the Write-In Student Editions helped with student engagement, learning, and a sense of pride in their work.

APPLICATION OF SCIENCE

When students were asked about the extent to which their science program helped them to apply and make connections between science and the real-world and other subject areas, no significant differences were observed between treatment students and control students. It is notable that the vast majority of students (over 80%) felt that their science program increased their understanding about the relevance of science to everyday life and stated that the program helped them make connections to real-world and other subject areas, see Figure 39. Similarly, both treatment and control teachers felt their science programs helped students make connections, see Figure 40. That said, anecdotal information indicates that Pearson Interactive Science teachers felt that the embedded connections to real-world events and concepts as well as the emphasis on applications to other subject areas, including math and reading, was both helpful to students' science learning and their interest in learning about science.

Figure 39. Perceptions of the Degree to Which Science Program Helped Students with Science Connections and Applications: PIS and Control Students
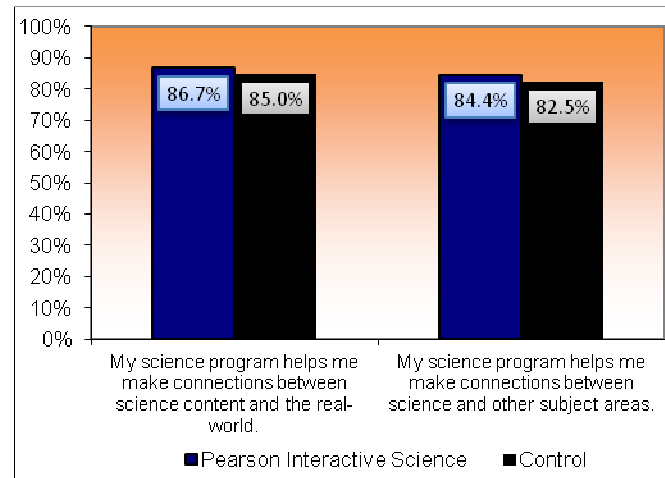
Figure 40. Perceptions of the Degree to Which Science Program Helped Students with Science Connections and Applications: PIS and Control Teacher
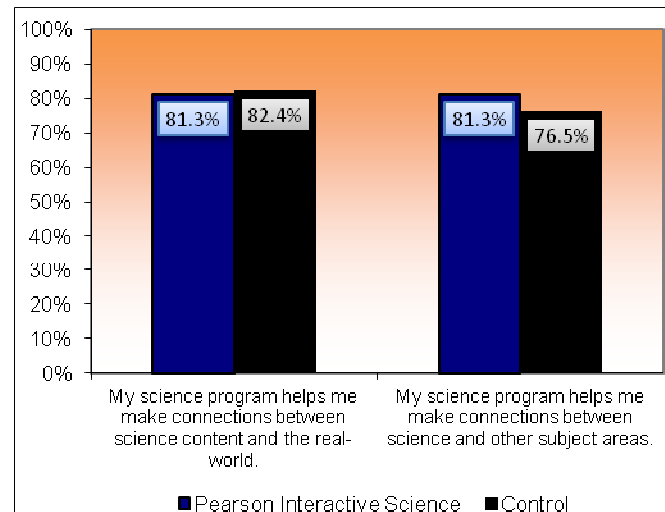
♦ *I can understand better because Pearson uses a lot of real-life situations. – Student*

♦ *I definitely like the real world connections that this series gives, it's a hook and that part I really like. – Teacher Site NY*

♦ *The topics are topics that have been there for years, but they make connections to the environments the children are in now, so that*

they'll get a better understanding of it. - Teacher, Site KY

The vast majority of teachers and students felt that the Pearson Interactive Science program helped students make connections between science, real world applications, and other subject areas. However, their perceptions were not statistically different from control students and teachers.

PREPARATION FOR FUTURE TESTS AND SCIENCE COURSES

Analysis of student surveys revealed that control students felt that their science programs prepared them for future tests and science courses more so than treatment students, $p<.05$, see Figure 41. Nevertheless, the level of agreement was high across both types of students. Examination of this information from teachers did not reveal significant differences but the trend was similar with a higher percentage of control teachers reporting that their science program prepared their students for future exams and courses, see Figure 42. The quantitative and qualitative data indicate that a little less than half of treatment teachers were not confident about the Pearson Interactive Science program's ability to assist students with their state assessments and other science tests. Qualitative data obtained from treatment teachers suggests that this lack of confidence may be partly to the fact that this is a new program and they did not have sufficient "proof" about the program's impact on future exams and courses.

Figure 41. Perceptions of the Degree to Which Science Program Helped Students Prepare for Future Tests and Courses: PIS and Control Students
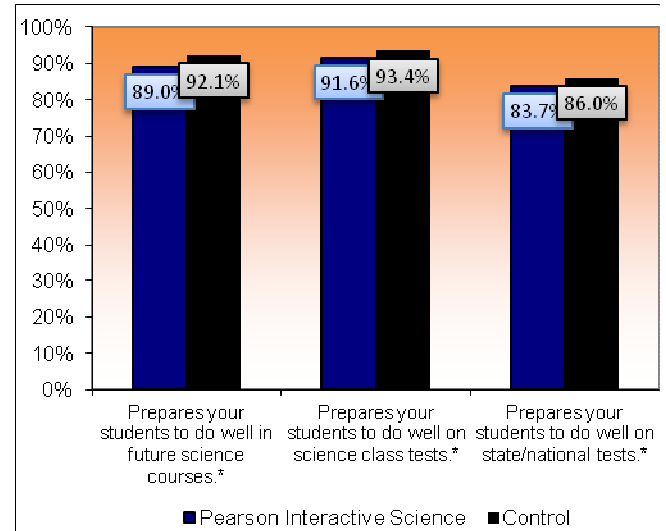
*p<.05

Figure 42. Perceptions of the Degree to Which Science Program Helped Students Prepare for Future Tests and Courses: PIS and Control Teachers
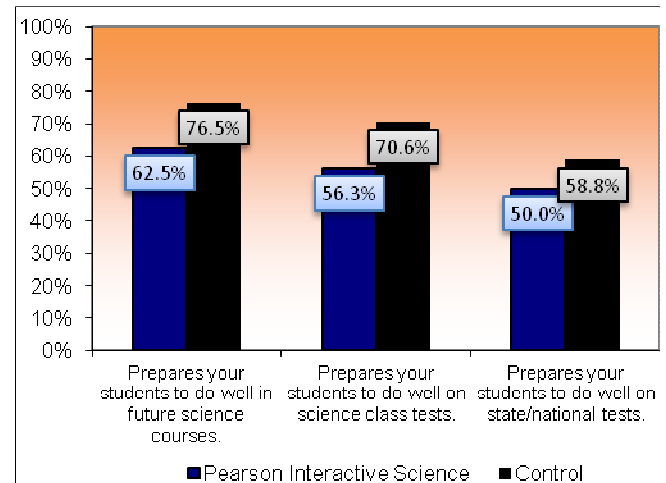
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Control students indicated that their science programs prepared them to do well in state/national tests and future science courses to a greater extent than treatment students.

IMPACT ON READING AND WRITING SKILLS

As shown in Figure 43, teachers and students reported that their science programs helped students with reading and writing skills relevant to science. Indeed, there were no noteworthy differences between treatment and control groups. Anecdotally, Pearson Interactive Science teachers commented that the numerous writing opportunities in which students are asked to explain their understanding of science concepts and apply their knowledge positively impacted these skill areas. In addition, the reading embedded within the PIS program was also viewed as beneficial.

Figure 43. Teacher and Student Perceptions of Impact of Program on Reading/Writing Skills By Group
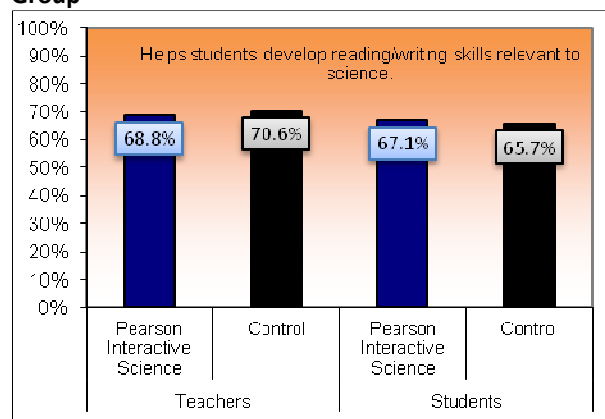
*Significantly different at the p<.05 level. Higher scores indicate more agreement.

♦ *I think the students have improved in reading and writing from this program. - Teacher, Site NY*

♦ *I think they've had to read more than they normally would. - Teacher, Site AZ*

While no differences were observed between groups, over 2/3rds of Pearson Interactive Science teachers reported that the program positively impacted their students' reading and writing skills due to the daily opportunities for reading and writing within the Write-In Student Edition.

TEACHER LEVEL OF PREPAREDNESS

Teachers were asked about how prepared they felt to: 1) engage in various types of science instructional practices and implement different types of best practice teaching strategies; and 2) teach the science content areas of Life, Earth, Physics, Chemistry, and Environmental Science. No significant differences were found in responses patterns between treatment and control teachers in terms of preparedness, see Figure 44.

Figure 44. Teacher Preparedness
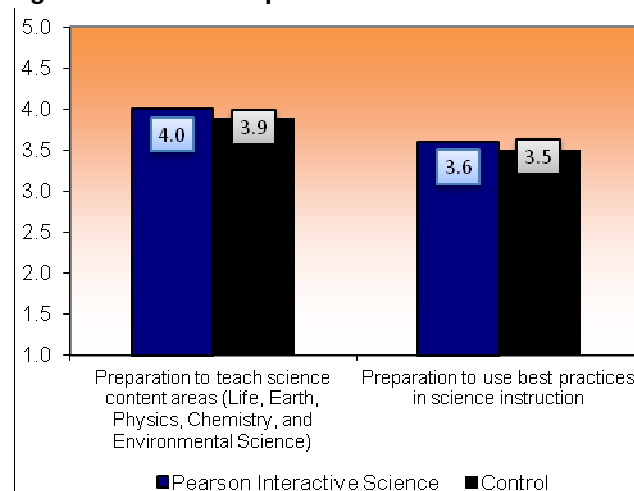
To further examine whether there were any significant changes among Pearson Interactive Science teachers, paired t-tests were conducted. Results showed that teachers felt their preparation to teach

various science content areas had improved from Fall to Spring, $p<.05$. As shown in Figure 45, teachers reported showing the greatest gains in preparation to teach Life Science, Physics, and Chemistry.

Figure 45. Treatment Teacher Preparedness to Teach Specific Science Content Areas
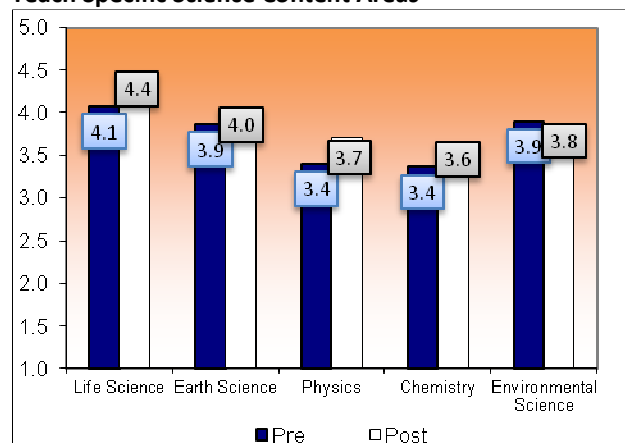
The Pearson Interactive Science program was associated with positive gains in teacher's preparedness to teach Life Science, Physics, and Chemistry.

INSTRUCTIONAL PRACTICES

Teachers were also asked about the typical classroom practices they incorporated into their instructional day. Analyses of the Spring survey, showed significant differences on a few activities. Notably, Pearson Interactive Science teachers tended to help their students develop and use problem-solving skills and provide students with opportunities to explain their thinking to a greater extent than control teachers $p<.05$, see Figure 46. Note that such skills were reinforced via the 21st Century Learning component embedded throughout lessons. In contrast, control teachers noted they were more likely than treatment teachers to have students complete

laboratory activities and to write about observations made during labs, $p<.05$. Teachers who used the Pearson Interactive Science program also reported placing greater emphasis in their instruction on test taking skills, science review, and inquiry skill concepts, $p<.05$, see Figure 47. In sum, while control teachers reported greater hands-on activities, treatment teachers reported greater emphasis and engagement in higher-order thinking skills, including inquiry skills.

Figure 46. Teacher Practices By Group
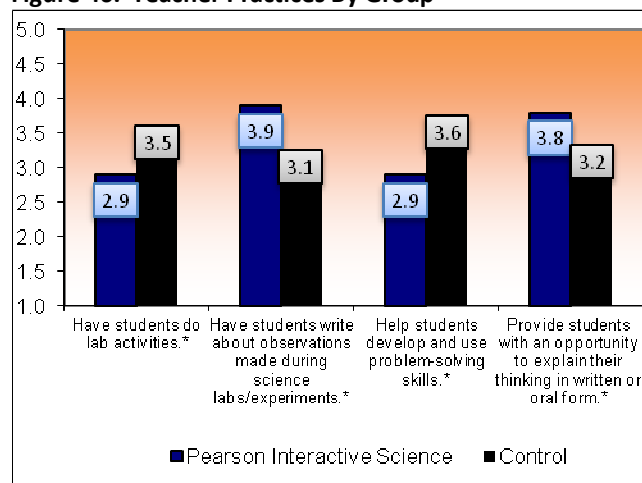
Figure 47. Teacher Emphasis in Instructional Areas By Group
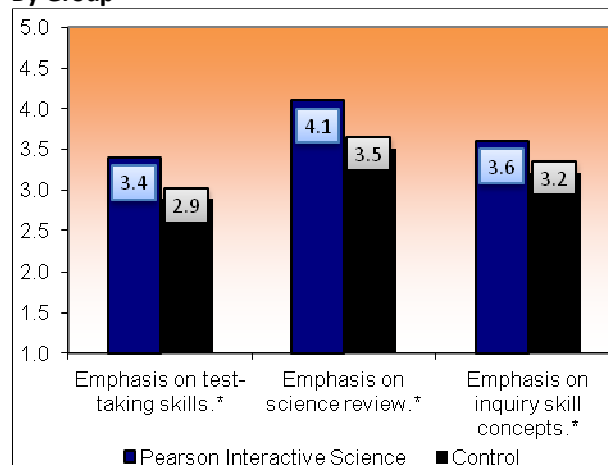
♦ *It actually did help me give a little more depth to our curriculum, it made me stop and address some real world issues that I*

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wouldn't have; this text definitely focuses more on that. – Teacher Site NY

♦ *It made me stop and think about some of the activities I do, I looked more at how this would impact student learning and I think the book encourages more student led learning and I like that. – Teacher Site NY*

In comparison to control teachers, Pearson Interactive Science teachers reported that they engaged in more activities designed to assist student's problem-solving skills. Additionally, treatment teachers tended to emphasize test taking skills, science review, and inquiry skill concepts to a greater extent than control teachers. Control teachers reported greater use of labs and writing about observations made.

Differentiated Instruction

In general, teachers also reported that their science program provided them with assistance to provide differentiated instruction to students at all levels (low, average and advanced) – however, when treatment and control comparisons were made there were no significant differences, $p>.05$. Although not statistically significant, control teachers generally felt that their science programs provided more assistance with differentiated instruction than teachers using the Pearson Interactive Science program, see Figure 48. Such differences may be due to the fact that control teachers were using materials to differentiate instruction that they had developed over the years and thus were more adept than treatment teachers at using these resources. For example, while Pearson Interactive Science teachers felt that they had ample resources available within the program to

assist students at varying levels, including ELLs, some had difficulty incorporating available resources into their instruction and instead taught to the "average" student. Indeed, differentiation activities for students occurred with little frequency by the majority of teachers (only 26% used them regularly).

Figure 48. Teacher Perceptions of the Degree to which Science Program Helped with Differentiated Instruction By Group
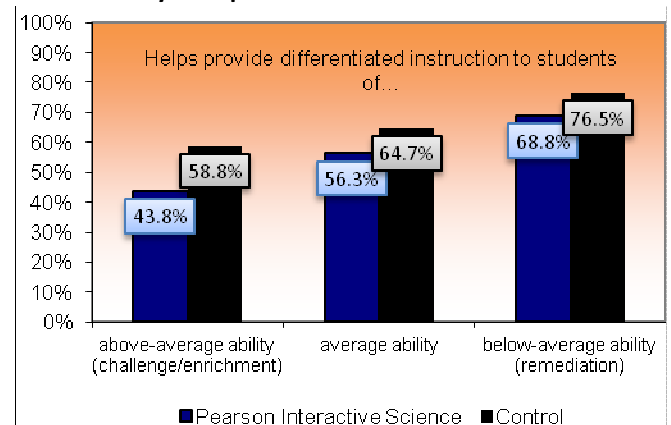
♦ *It's taught me some new ideas and new ways of looking at some things and I always look for new ideas to help different types of students. – Teacher Site NV*

♦ *I think the ELL stuff is nice, I can appreciate that you have the different paths, there's a lot here. - Teacher, Site AZ*

Over half of Pearson Interactive Science teachers felt that the program provided them with assistance to provide differentiated instruction to students at average and below-average levels, but not for above-average students. However, control teachers generally had higher perceptions about their programs' assistance with differentiated instruction.

Progress Monitoring

When analyzing perceptions about the assistance science programs provided in assessing student progress and learning, results from teacher surveys indicated that generally control teachers perceived greater assistance from their programs, although differences were not significant, $p>.05$. As shown in Figure 49, the majority of teachers using other science programs (over 80%) felt that their programs provided them with useful information to monitor progress during and after science lessons whereas approximately 70% and 63% of treatment teachers agreed. That said, it should be reiterated that for the most part, control teachers employed progress assessments that they have been using for several years and as such, they felt more comfortable with the information they yield. In comparison, although the PIS program has embedded checks to assess student understanding (e.g., Got It, Assess Your Understanding, Lesson Quiz), some treatment teachers commented that students would not accurately note whether they "got" a concept or not. In addition, Assess Your Understanding and Lesson Quizzes were sometimes used as a whole group review activity or completed in small groups so teachers did not use it to measure individual students' understanding of concepts.

Figure 49. Percent of Teachers Who Agreed their Science Program Helped Them Monitor Student Progress By Group
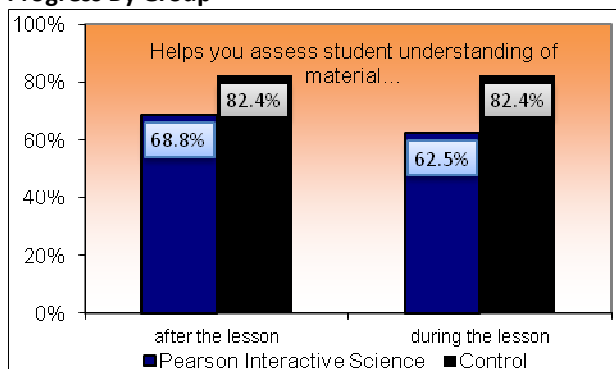
A higher percentage of control teachers perceived greater assistance from their science programs in helping them assess student understanding of science as compared to teachers using Pearson Interactive Science.

Teacher Support

Teachers were also asked about the extent to which their science programs provided them with support (e.g., in lesson planning, in selecting activities, etc.). As shown in Figure 50, there were no significant differences between treatment and control teachers in terms of teacher support offered by their programs although trends were evident. For example, teachers using the Pearson Interactive Science program felt that this program was helpful for teaching science vocabulary and providing them with sufficient resources to a greater extent than control teachers. In terms of pacing and lesson planning, a higher percentage of control felt their program was helpful as compared to teachers using the Pearson Interactive Science program. The percent of teachers who felt the science program provided good ideas for hands-on activities was fairly comparable. These findings are consistent with anecdotal information obtained from treatment teachers. In particular, teachers commented that the Pearson Interactive Science program was rich in resources and a great tool for learning science vocabulary given the emphasis the program places on vocabulary (e.g., Vocabulary Skill, highlighting of vocabulary throughout the text, etc.). As a new program, treatment teachers felt it took time to adequately prepare for each lesson and the pacing was initially problematic as it took time for teachers to become

comfortable with the structure of the PIS program. Most, however, commented that for the upcoming year they will have better pacing of their lessons following their first year of implementation.

Figure 50. Teacher Perceptions of the Degree to Which their Science Program Provided Them with Support By Group
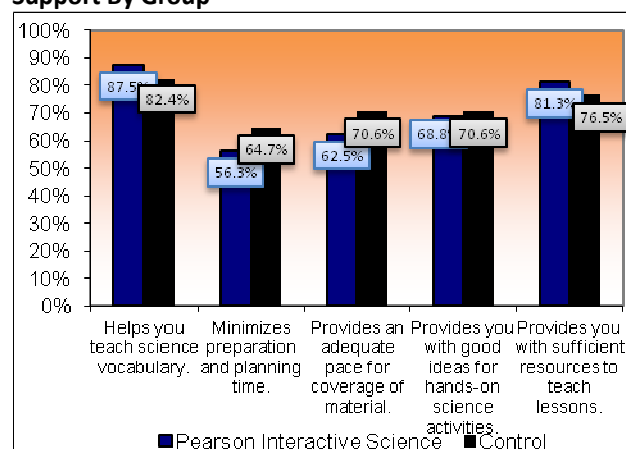
- *Anytime you use something like this, the first year is hard, but you can add the resources the longer you use it, the next year or the year after. - Teacher, Site AZ*

- *I really like having it all online, that has been nice, not so much for using with the kids, but using it with myself, so then as I'm thinking about something and I'm at home I can access it. I can't go onto campus anytime, so having it online helps. – Teacher Site AZ*

- *One of the biggest areas we're lacking with kids is vocabulary and I hugely love how the vocabulary is highlighted and the highlighting of the keys, we frequently go back to those, so the fact they are highlighted, have the key symbol and stick out, is very helpful. – Teacher, Site PA*

While no significant differences were observed, teachers using the Pearson Interactive Science program reported that the program was more helpful for teaching science vocabulary and providing them with sufficient resources whereas control teachers felt their program was more helpful in terms of pacing and lesson planning.

In summary, results showed that while the Pearson Interactive Science program produced positive effects on student learning, this did not always translate to positive changes in student and teacher attitudinal outcomes. For example, students using other science programs felt more strongly about their science abilities and enjoyed science more as compared to students using Pearson Interactive Science. Furthermore, control students indicated that their science programs prepared them to do well in state/national tests and future science courses to a greater extent than treatment students. Control teachers also generally had higher perceptions about their programs' assistance with differentiated instruction, progress monitoring, lesson preparation, and pacing as compared to treatment teachers. That said, positive changes were observed in other areas. For example, Pearson Interactive Science teachers reported being better prepared to teach various science content areas from Fall to Spring. In comparison to control teachers, Pearson Interactive Science teachers reported that they engaged in more activities designed to assist student's problem-solving skills and tended to emphasize test taking skills, science review, and inquiry skill concepts to a greater extent than control teachers, though differences were not significant. Students using the Pearson Interactive Science felt that the Write-In Student Edition provided them with useful

information to learn and understand science which was facilitated by the Lab Zones and visual representations. Teachers also noted that being able to write in the Write-In Student Editions helped with student engagement, learning, and gave students a sense of pride in their work. Additionally, the vast majority of teachers and students felt that the Pearson Interactive Science program helped students make connections between science, real world applications, and other subject areas.

What do users of the Pearson Interactive Science 2011 program think about the program? What aspects of the program do they find most useful? Least useful? What, if any, suggestions for program improvement do they have?

STUDENT PERCEPTIONS

Analysis of student surveys showed that students in Pearson Interactive Science classrooms enjoyed using the program, and liked it a little better than their previous science program, see Figure 51. In particular, feedback from students indicated that in general, they liked the Pearson Interactive Science Write-In Student Edition. As previously noted, students commented that they liked that they could write and highlight in the Write-In Student Edition and exhibited a pride of ownership in it. Students also commented that the Write-In Student Edition was lightweight and portable. They liked that they did not have excess worksheets and notes to carry around but rather could use the Write-In Student Edition as a primary source for assignments and note taking.

Figure 51. PIS Student Average Rating on the Extent to Which the PIS Program Compares to Last Year's Science Program
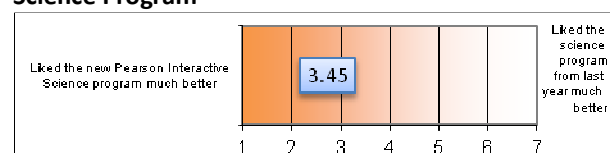
- *The new Pearson Interactive science books help you understand the topic better, they are lightweight, they compare to life things and they interact with you with picture, drawings, and diagrams. - Student*

- *I like that you could write in the PIS text book and that the books were light. - Student*

- *I liked the fact that everyone got their own paperback [Pearson Interactive Science] textbook, it made it easier to work in because we didn't always have to copy answer onto separate sheets of paper. - Student*

As shown in Figure 52, the majority of students using the Pearson Interactive Science program agreed that they would like to use the program next year (76%), and that overall they liked the student Write-In Student Edition (80%).

Figure 52. Percentage of Students Who Agreed They Liked the PIS Program
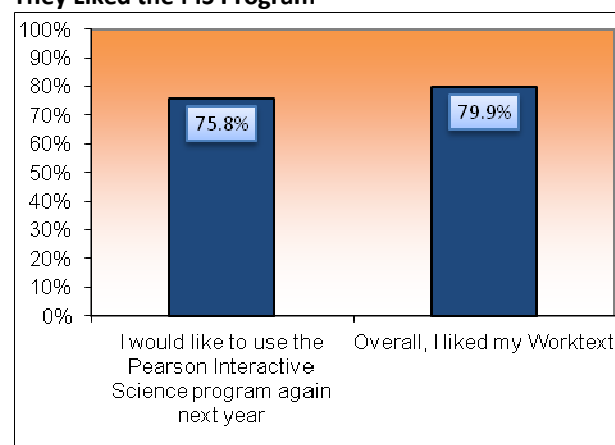
The majority of treatment students also indicated that they liked having a complete record of their science work and learning (84.5%) and stated that they thought the science activities included in the program were fun and interesting (81%), see Figure 53. The majority of treatment students (81%) also indicated that they used their Write-In Student Edition when studying for tests and quizzes. Thus, students not only relied on their Write-In Student Edition for learning but also found the content engaging.

Figure 53. Percentage of Students Who Agreed They Liked the PIS Write-In Student Edition.
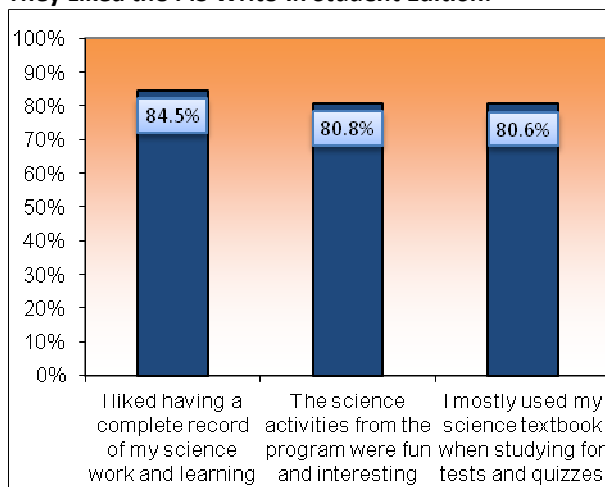
While there was a lot of positive feedback with respect to the Person Interactive Science program, and especially the ability to write in the books and its ease of use, there were also students who found the program less challenging than other science programs. While most students said that the program was easy to use and helped them to learn science better, some students (particularly older students) felt that it was not challenging enough for them and that the science concepts were not in depth enough for them to really learn and understand. Preference (or lack thereof) for the program may have more to do with differences in student learning styles and how they prefer

to learn. Below are sample comments that illustrate this varying feedback:

- *I like the Pearson Interactive books, but I wish that it would elaborate more on topics. The books were ok but the subject was "watered down," and slowed down the learning process. - Student*

- *I did somewhat enjoy learning from the PIS program, but only because it was easy. I like to be challenged to really understand now science works, and PIS did not give me that satisfaction. I remember almost everything from my old program, but information learned from PIS was easily forgotten. - Student*

- *It's easier for me to learn the material when I can make notes in my textbook and have to answer questions. The interactions helped me involve myself. - Student*

- *This year's [Pearson Interactive Science] was better because the book actually broke things down and explained them when last year it was textbooks that were all words and really hard to read. - Student*

The majority of students enjoyed using the Pearson Interactive Science program and would like to use the program during the following school year. In general, they liked being able to write in their Write-In Student Editions and having a complete record of their science learning in one source.

Comparisons were made between treatment and control students about the extent to which they enjoyed their science program this year. Results showed a significant difference between treatment and control students in their enjoyment of using their science textbook to learn, with

treatment students indicating greater enjoyment than control students, $_{p<.05}$. Results also showed a significant difference in favor of control students in their ability to maintain good science notes, $_{p<.05}$, see Figure 54. This is surprising as many students commented that they were able to keep good notes using their PIS Write-In Student Edition this year. This finding may be because control teachers were more likely to have students take directed notes to supplement their textbook and thus their students felt they took well-organized science notes during the school year.

Figure 54. Student Rating of their Science Program by Group
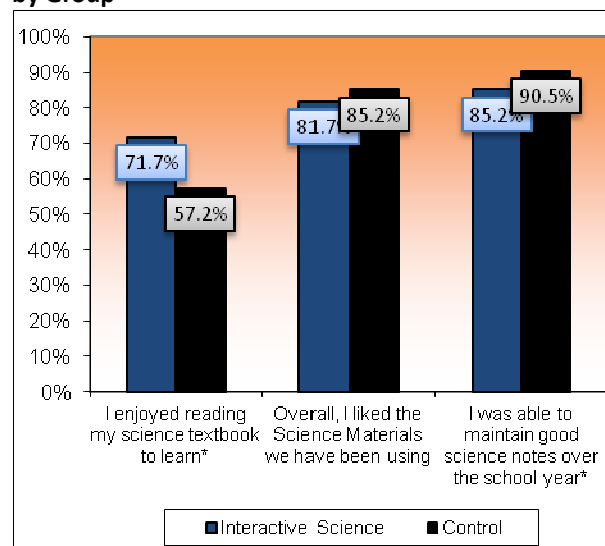
*Statistically significant at $p<.05$.

- ♦ *It's [Pearson Interactive Science] a lot better. I feel it is more organized and better for note taking. - Student*

- ♦ *PIS helped me learn science better because of the book. The book lets us read about it then it asks questions on what we learned. – Student*

Students were also asked to rate their respective science programs according to specific adjectives. Specifically, students were asked to rate the program on a scale from interesting to boring, easy to difficult, useful to useless, fun to not fun, and good to bad. Figure 55 shows the results of these ratings. There were no significant differences in ratings between treatment and control students. In general, treatment students rated the program as being slightly more good and fun while control students rated their program as being slightly more useful and interesting. Both treatment and control students rated their science program as being somewhat easy. Ratings between treatment and control students were very close as most students enjoyed science regardless of the textbook they were using.

Figure 55. Average Descriptive Ratings by Pearson Interactive Science and Control Students
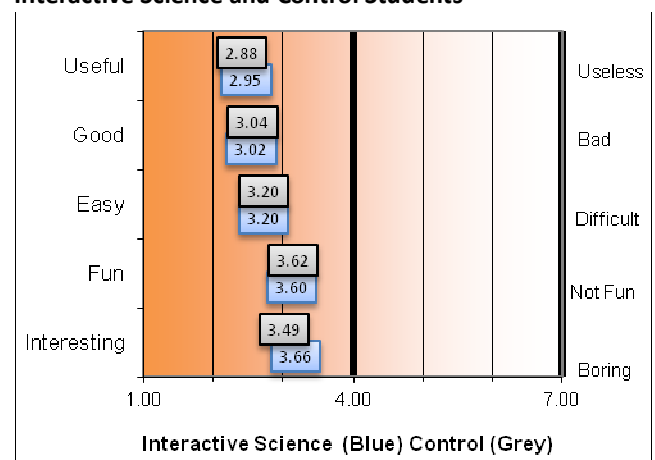
Comparisons between treatment and control students showed that while control students felt they were able to maintain better science notes, Pearson Interactive Science students enjoyed reading from their text to a greater extent than control students. Descriptive ratings (e.g., good, fun, interesting) of science programs was similar between groups.

Information obtained from treatment teachers indicated that they liked the Pearson Interactive Science program somewhat better than the science program they had used previously, see Figure 56. Overall, they felt that the program was easy to understand, engaging and well-organized. They also liked having multiple resources from which to draw upon as needed to help students both understand and enjoy science.

Figure 56. Teacher Average Rating on Quality of PIS Program Relative to Prior Science Program
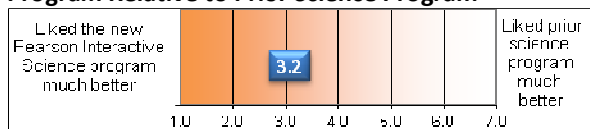
♦ *I cannot see why this program wouldn't change science education across America. - Teacher, Site KY*

♦ *I liked the science book much better than what I have used the last few years. I think the material is presented in a way that the students like better and they are more inclined to read the text. – Teacher, Site AZ*

Comparisons of teachers' overall ratings of the Pearson Interactive Science and control programs show no significant differences, $_{p>.05}$. However, satisfaction ratings of the Pearson Interactive Science teachers tended to be slightly higher than those of the control teachers. Specifically, 93% of treatment teachers reported that the PIS program provided teachers with useful information to effectively teach science compared to 88% of control teachers. Overall, the majority of both treatment teachers and control teachers were satisfied using their respective science programs in their classrooms and would like to continue to use their respective science program in the upcoming school year, see Figure 57.

Figure 57. Teacher Perceptions of Science Programs by Group
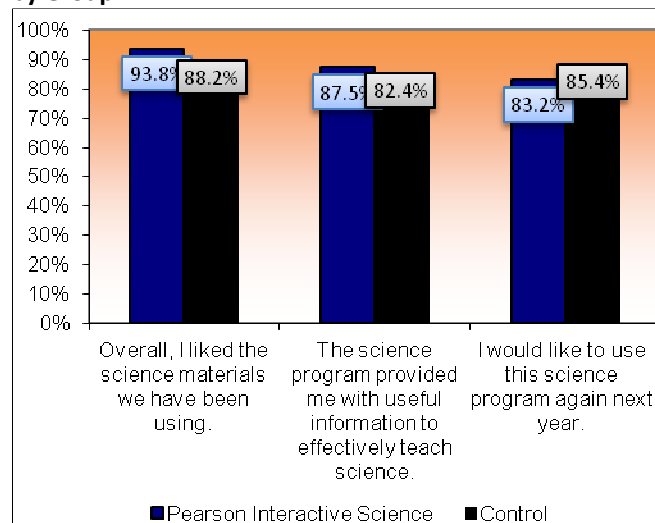
♦ *Very informative textbook for students. It was very up to date with current topics. I like the lay out in helping me plan the lessons. – Teacher, Site PA*

♦ *I will continue to use the book with the students next year and the kids liked the book better than the one they had last year. – Teacher, Site AZ*

In general, teachers felt that the Pearson Interactive Science was better than their prior science program. Although no significant differences were observed between treatment and control teachers, Pearson Interactive Science teachers felt the program helped them effectively teach science and would like to use the program again next year.

When asked about the extent to which teachers felt their students enjoyed their respective science programs results showed a marginally significant difference between treatment teachers and control teachers in that treatment students (62%) spoke more

positively than control students (47%) about their science textbook, $_{p<.05,}$ see Figure 58. Treatment teachers also indicated that their students (43%) enjoyed reading their science Write-In Student Edition to learn science more than control students (29%). Regarding the importance students placed on having a complete record of science work, control teachers and treatment teachers had similar ratings (approximately 50%). Analysis of qualitative data suggested that most teachers felt their students enjoyed the Pearson Interactive Science program. Teachers noted that students thought the program was fun and that they really liked to write in the Write-In Student Edition. However, some teachers noted that this was a novelty that eventually "wore off" and students took to "doodling" in the Write-In Student Edition. This was specifically evident in the 8th grade as teachers noted that some students found the questions and lab activities to be a little too elementary for them.

Figure 58. Teacher Perceptions about Student Attitudes Toward Their Science Program
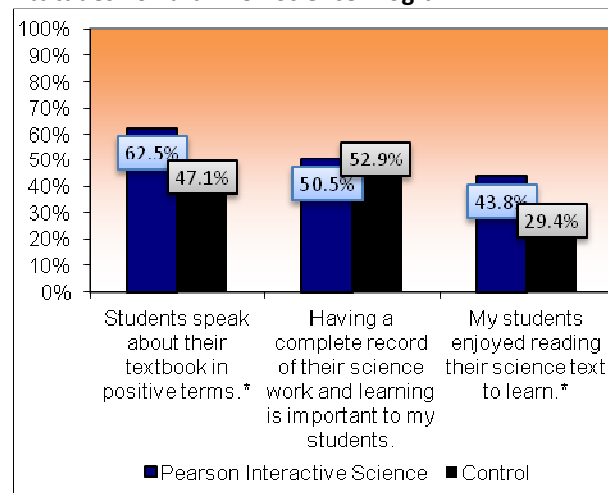
*Marginally significant $p<.10$

- *I think I'm getting better questions out of them [PIS students], I'm getting higher-level thinking and I guess I would say that's because of the book. – Teacher, Site NY*

- *They (students) appreciated it [Pearson Interactive Science] and liked working independently. - Teacher, Site NY*

- *I think that having a current book [Pearson Interactive Science] raises their level of interest; in the world of science so much changes, so if the book we have doesn't stay current the kids can't make those connections. – Teacher Site AZ*

- *From the comments I've received [from PIS students] they were overwhelmingly positive, some of them said they felt like more of a student, because they have texts they can highlight. – Teacher, Site PA*

- *I liked the program [Pearson Interactive Science], especially at the beginning. The students thought it was really cool to have a book they could write in, then it became a place for their art drawings.– Teacher, Site AZ*

Treatment teachers also commented that they liked the way the Write-In Student Edition provided students with concrete real world connections through the My Planet Diary, Big Questions, Untamed Science Videos and Figures/Activity Art. The program is current, relevant and up to date with recent events such as the 2008 earthquake that devastated China.

- *It helped them [PIS Students] to see the reference in their world to something that was abstract and the relationships that went on with it. - Teacher, Site KY*

- *I love the Big Ideas of science, my kids go back to those all the time and I am surprised with what they come up with in relation to them and their world. - Teacher, Site PA*

- *I like the book, as far as, it's very current, the kids like looking at all the pictures - they're always wanting to look through the*

book to see all the pictures. – Teacher Site AZ

Pearson Interactive Science teachers reported that they felt their students spoke more positively about their texts and enjoyed reading from their Write-In Student Editions as compared to control teachers. They also liked the real world connections embedded within the Pearson program.

PEARSON INTERACTIVE SCIENCE RESOURCES AND PROGRAM COMPONENTS

In general, treatment teachers appreciated the diversity of resources and components provided, noting that they especially liked their Teacher's Edition in its organization and easy lesson prep. One teacher in particular noted that he was able to learn more information during his lesson prep as the information was so in depth. Another teacher noted that the Teacher's Edition helped her to revisit and use different learning styles to the various types of learners in her classroom.

♦ *I did like and used a lot of the stuff in the teacher's edition, they have ideas from other teachers and I've used quite a few of those, I liked those a lot. - Teacher, Site AZ*

When asked to compare the Pearson Interactive Science program to the previous year's science program in terms of quality, ease of use, planning time, and overall design, the treatment teachers felt that the PIS program was about the same or better than their old program. Specifically teachers noted that the quality of resources provided was better than their old program and rated teacher ease of use, amount of planning/prep required and overall

presentation of Teacher's Edition as slightly better, see Figure 59. Anecdotal information obtained from PIS teachers indicates that teachers particularly liked the availability of all the resources, especially the lab resources, and noted that they liked the ability to approach the program with a blended path using the textbook, inquiry and technology. Initially teachers reported feeling somewhat overwhelmed by the plethora of resources, however once they became more familiar with the program the majority of teachers indicated the variety of resources as one of the greatest strengths of the program. A couple of teachers however did find the program to be less teacher friendly than others noting that it was confusing to not have all the resources together. Some teachers also commented that while they liked having all the resources available to them, they simply did not have enough time to use everything.

Figure 59. Teacher Attitudes about Ease of Use and Resources of PIS Program Relative to Prior Science Program
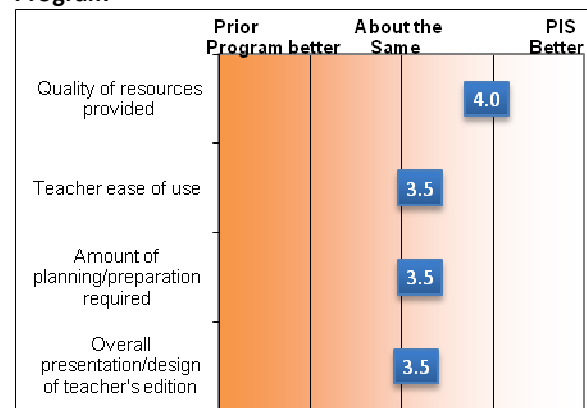
♦ *I think a new teacher would love it [Pearson Interactive Science] it's pretty teacher friendly; I think it's harder for a veteran teacher to use, because they have so much of their own things to bring to the table. - Teacher, Site AZ*

♦ *I loved the [Pearson Interactive Science] Teacher's Edition, the objectives are right*

there, they have you know, the pacing broken down into three different times and I liked that. - Teacher, Site AZ

Additionally, some teachers noted that the pacing of the program was slow and a few teachers found it challenging to complete all the required activities of the program within a reasonable time frame. It was noted that the pacing was especially difficult to maintain while completing lab activities as some teachers could not complete the lab activities within the estimated time allotted. Teachers who had longer blocks for science instruction noted that they had less trouble with pacing and that they were able to complete a lesson in a reasonable time frame.

♦ *Pacing is long, slow, way too much and takes way too much time. As a program itself, there is not enough time in the year or day to do all of it. - Teacher, Site AZ*

♦ *It's nice to offer the pacing and it's nice to speed it up or go slower, so it's useful to see another perspective. However, the times for the labs aren't accurate and that throws the whole pacing off, it takes more time to do the lab than what it says. – Teacher, Site AZ*

Both treatment teachers and students were asked to rate aspects of the Pearson Interactive Science Write-In Student Edition in comparison to previous year's Student Editions. Both teachers and students rated the organization of the PIS Write-In Student Edition to be slightly better than last year's science textbook, see Figure 60. Teachers also noted that the overall presentation/design and format of the Write-In Student Edition was better than the previous year's science textbook.

Figure 60. Teacher and Student Attitudes about Organization and Design of PIS Write-In Student Edition Relative to Prior Science Program
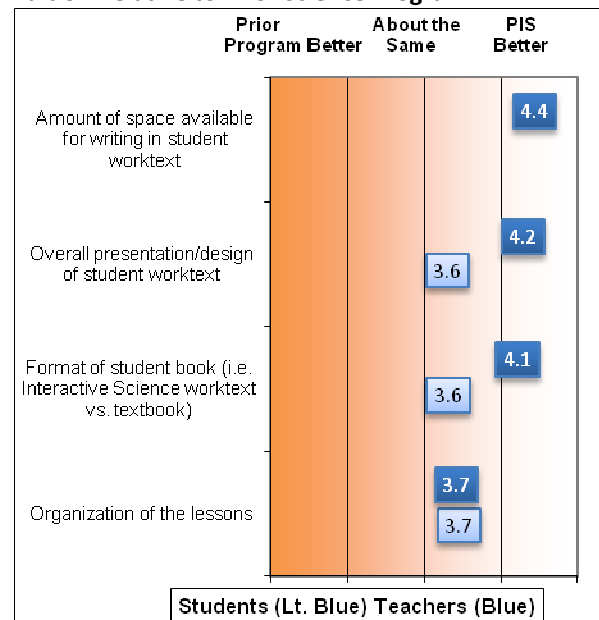
♦ *The kids loved it [Pearson Interactive Science], they commented on how better organized it helped them to be, the answers were right there, it wasn't like a trick question, the series wanted them to learn and to know the answers to the questions. - Teacher, Site KY*

♦ *I like how [Pearson Interactive Science] is organized, the chapters are generally organized well, sometimes the lessons don't flow well within the chapter, sometimes there are too many lessons where they could combine two into one would have been better, but otherwise a well put together program. - Teacher, Site NY*

♦ *[PIS] Students really take ownership of their books and they didn't loose a single one. – Teacher Site NY*

♦ *I like the consumable text because it forces the kids to interact with the reading and they like that aspect of it as well, to some degree I think it makes them feel like a student,*

because they're taking notes and that type of thing. - Teacher, Site PA

♦ *Some commented that it was easier for them to remember what they were talking about because they can write notes in their book. – Teacher, Site PA*

In general, treatment teachers appreciated the diversity of resources and components provided, noting that they especially liked their Teacher's Edition in its organization and easy lesson prep. Students and teachers also felt that the overall presentation/design, organization, and format of the Write-In Student Edition was better than the previous year's science textbook.

Teachers and students were asked to compare specific program activities in the PIS Write-In Student Edition to the previous year's science program. Teachers rated the math activities and student ease of use in the PIS program as better than last year's science program, see Figure 61. Both teachers and students also rated the PIS program as slightly better in the following areas (i.e., ratings are above the midpoint of 3.0): how science is explained, writing activities, how questions are presented, science labs and types of science exercises. Qualitative analysis revealed that most of the teachers especially loved the inclusion of math in the PIS program noting how important that was as math and science are closely linked.

Figure 61. Teacher and Student Attitudes about PIS Program Activities Relative to Prior Science Program
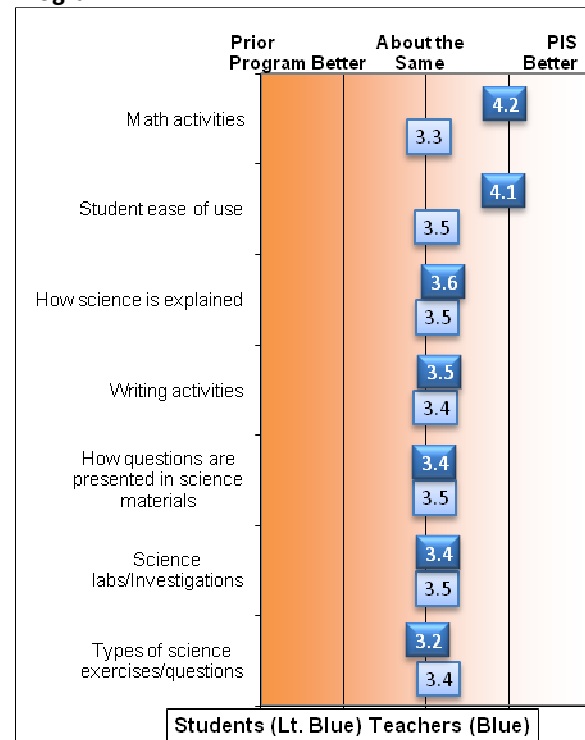
♦ *Pearson's is the best science book I have ever taught, one of the main reasons is because it's interactive with the child. The questioning and illustrations that back up what you're talking about are great. - Teacher, Site KY*

♦ *It's nice how they've integrated the math. - Teacher, Site AZ*

♦ *As an overall they automatically look at a graph and think 'I can't do that.' By embedding those in every single lesson I'm getting less resistance. If I am able to lessen their fear of seeing a graph and having to answer something, then when they get that on their state testing I've lessened that fear and they know they can handle it. – Teacher, Site PA*

♦ *The [Pearson Interactive Science] books the kids liked them, the graphics are great, the little side stories are nice. - Teacher, Site NY*

Regarding the organization of the Write-In Student Edition, over 3/4s of the treatment teachers (78%) and students (80%) agreed that they liked having the Write-In Student Edition serve as students' single source for science notes and learning. Similarly, a large majority of teachers and students also agreed that the organization of the Write-In Student Edition around the Big Question helped them to organize their lessons, see Figure 62.

Figure 62. Percentage of PIS Teachers and Students That Agreed They Liked the Organization of the Student Write-In Student Edition.
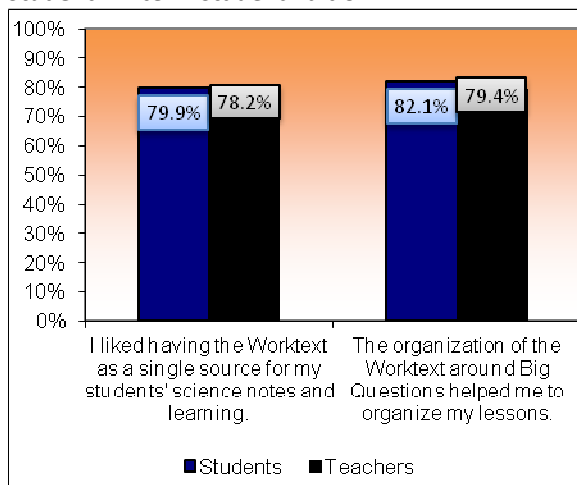
The majority of teachers rated the math activities and student ease of use of the PIS program as better than their prior science program. In addition, most teachers and students liked the organization of Write-In Student Edition around the Big Question and having the Write-In Student Edition as a single source for notes.

Ratings of specific Pearson Interactive Science components indicated that the majority of teachers found key components of the program to be useful, see Figure 63. Specifically, over 60% rated the vocabulary, Check Your Understanding, Untamed Science Videos, Lab Activities, Assess Your Understanding, Big Question, UbD pedagogy, Apply it! and My Planet Diary as useful to very useful.

Figure 63. Teacher Ratings of the Usefulness of the Core PIS Program Components
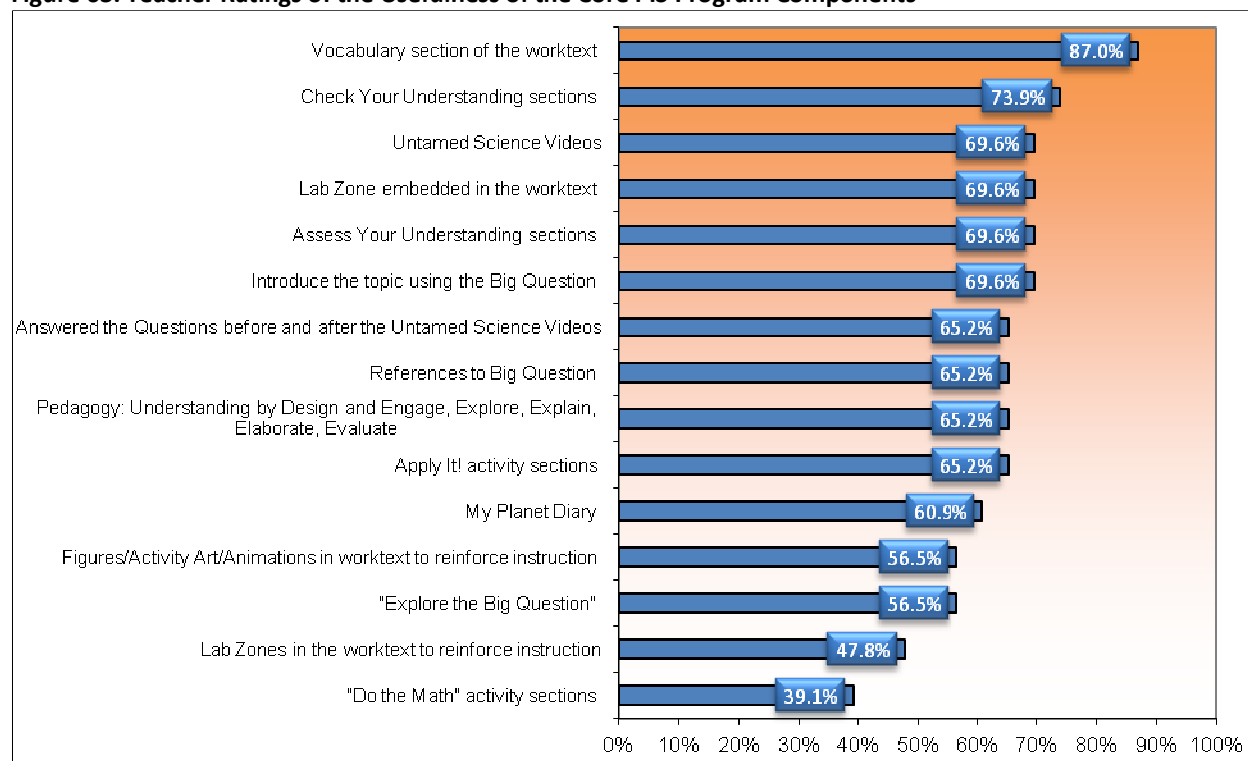
An analysis of qualitative data revealed that teachers especially loved the highlighted vocabulary words included in the Write-In Student Edition noting that science vocabulary is extremely important. Reviews regarding the Untamed Science Videos were mixed as some teachers commented that their students loved the videos and they liked the motivating introduction to the chapter. Other teachers, however, commented that the videos were too short and sometimes "cheesy". Many teachers also reported that they enjoyed the My Planet Diary segments in its real world application; however, some noted that they didn't always match the concepts within the lesson. The "Got Its" in the Assess Your Understanding component were also mixed as some teachers commented that the liked the quick learning check and chunking of the lessons while others commented that they came up too frequently and students would always check they "got it" even if they did not.

- *One of the biggest areas we're lacking with kids is vocabulary and I hugely love how the vocabulary is highlighted and the highlighting of the keys, we frequently go back to those, so the fact they are highlighted, have the key symbol and stick out, is very helpful. – Teacher, Site PA*

- *The digital component is awesome; my kids love the Untamed Videos. I like the fact that it's the same people and my kids are used to that. - Teacher, Site PA*

- *The kids wanted to watch the Untamed Science Videos all the time. The labs too, they would ask everyday if they were going to do a lab today. – Teacher Site OH*

The Untamed Science were nice introduction, motivating, I would say maybe 50% of the Planet Diaries were nice little motivators, but some of them didn't actually seem linked to the lesson itself. - Teacher, Site NY

I think the program [Pearson Interactive Science] is much better and has great pictures and Planet Diaries which relate to the world. - Student

Ratings of the Pearson Interactive Science components that were considered optional indicated that many teachers found these components to be useful as well. Specifically over 69% of teachers found the Study Guide, Lesson Quizzes and Key Concept Summaries to be useful to very useful. That said, some teachers commented that the Study Guide was not sufficiently aligned to chapter tests and only provided a brief overview of the chapter as opposed to a thorough study guide that could be used to prepare for the test.

Figure 64. Teacher Ratings of the Usefulness of the Optional PIS Program Components
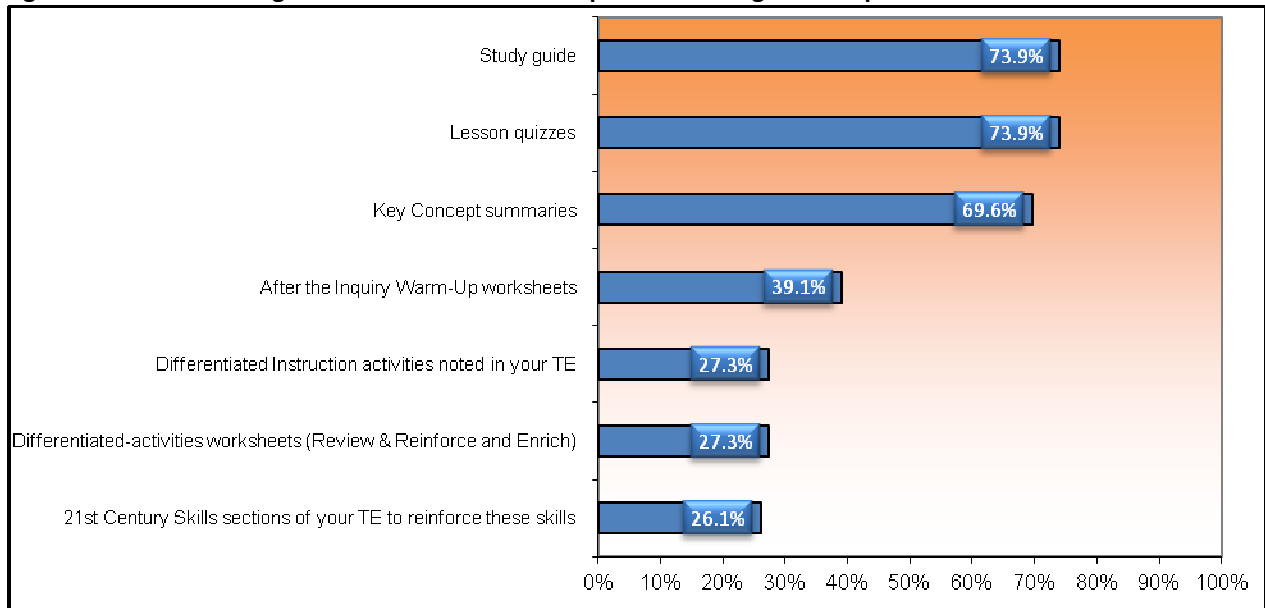
Figure 65. Average Rating of PIS Program Print Materials and Ancillary Resources
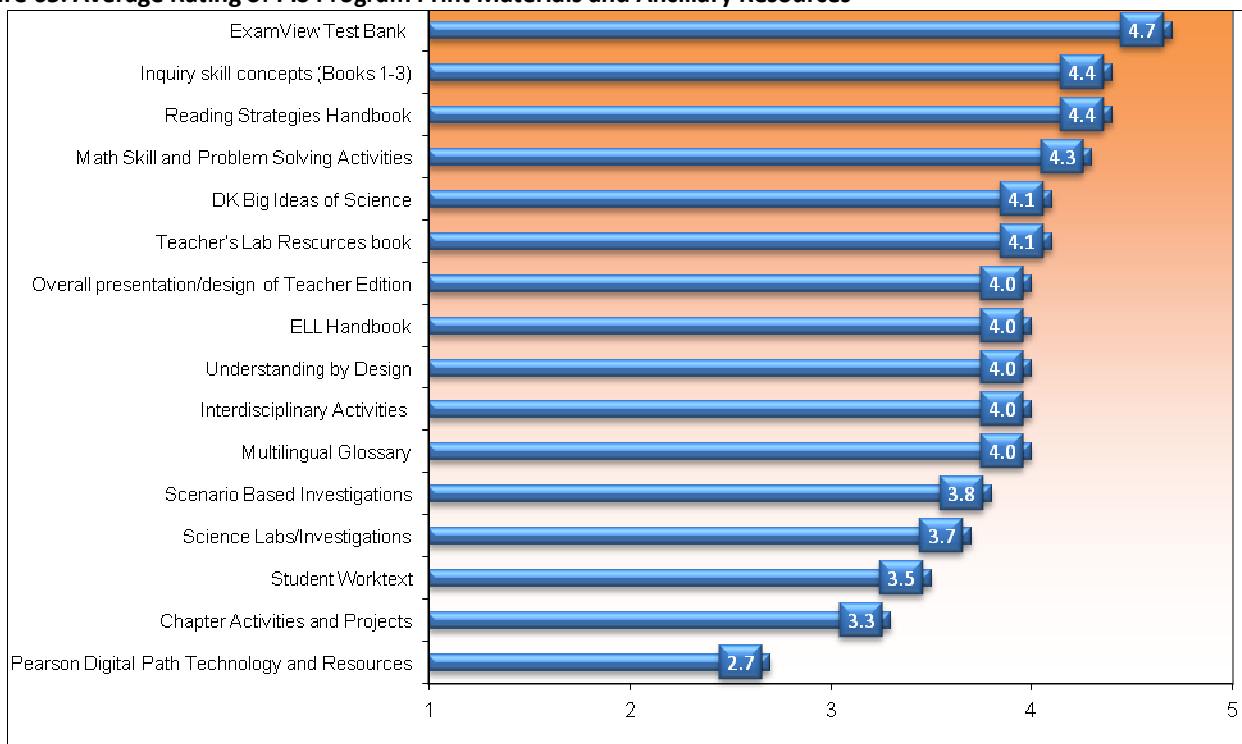
Figure 65 displays the average rating of teachers who found the Pearson Interactive Science program print, ancillary, and online digital path resources as useful. On a usefulness scale of 1 to 5, teachers rated the ExamView Test Bank, Inquiry Skill Concepts, Reading Strategies Handbook, Math Skill and Problem Solving Activities, DK Big Ideas of Science, Teacher's Lab Resources Book, Teacher's Edition, ELL Handbook, Interdisciplinary Activities and Multilingual Glossary to be useful to very useful.

Understanding by Design

As previously noted, the Understanding by Design (UbD) pedagogy of the PIS program was considered to be a key feature of the program. The majority of treatment teachers (87%) agreed that the UbD framework is a useful tool for science instruction and was useful in providing instruction to different types of learners (82%). Furthermore, 78% of teachers using the PIS program felt the consistent lesson plan under UbD helped students to learn science better and the organization of the program was an effective instructional tool (73%). Teachers also agreed (65%) that UbD helped students develop a deeper understanding of the science content, see Figure 66.

Anecdotal information obtained revealed that teachers loved the organization of the lessons around the 5 E's and felt that the repetition of this organization had a positive impact on students retention of the material. It was noted by one teacher that because it was so predictable the students knew what to expect and would start thinking about discussion questions and how the concept could be applied. A couple of teachers also noted that the Ubd framework was especially useful for their lower level

students and that this framework provided the teachers with new ideas for differentiated instruction.

Figure 66. Teacher Ratings of Understanding by Design
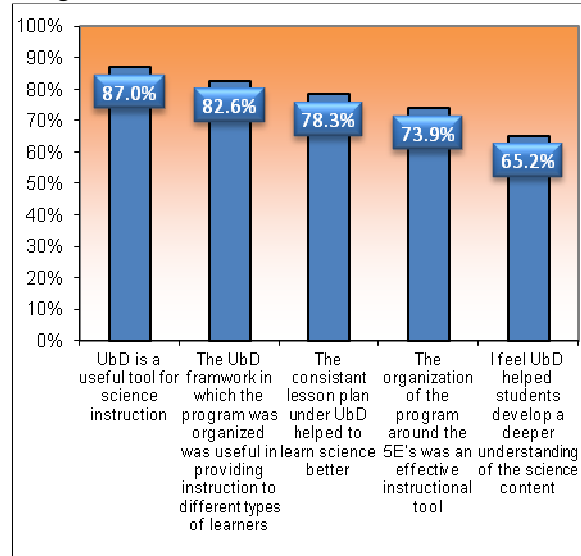
- *UbD anchors the topic, the kids are able to, most of the time, come away with at least something, maybe they don't have all the pieces, but they have most of the pieces to answer that question somewhat competently. - Teacher, Site NY*

- *I love the UBD framework I really believe that you start with the Big Idea questions. – Teacher Site NY*

- *The five E's I think is fantastic; I think it all goes back to repetition and tying the whole picture together for the kids, it completes the circle and so the kids aren't sitting there wondering, ok well where does that fit in with it and I like that a lot. They just get that complete picture. - Teacher, Site AZ*

- *The going backwards where everything relates back to the Big Question, I think that's great; I think it's constantly a reminder for the kids and everything ties into*

it and I think it makes it easier for kids to see the overall picture with it. - Teacher, Site AZ

- *This is the model that we've been following when we write our curriculum (UbD). If you want to know where you need to end up, it kind of helps to build backwards and take a look at where things are coming from; yes I think it's a model that correlates with where our district is headed. - Teacher, Site PA*

Overall, treatment teachers reported that Understanding by Design is a useful tool for science instruction. They also felt that the consistent lesson plan under UbD helped students to learn science better.

Science Labs

In general, treatment teachers and students enjoyed using the Pearson Interactive Science labs. Both teachers and students indicated that they liked the labs from the PIS program somewhat more than the labs in their previous science program, see Figure 67.

Figure 67. Treatment Teacher and Student Rating of PIS Labs Relative to Prior Science Program
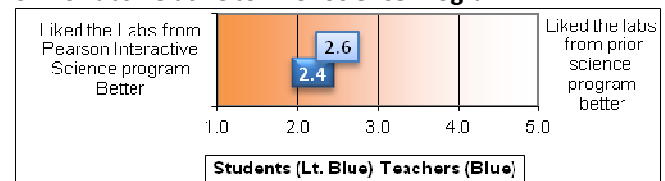
- *I liked the labs better this year [Pearson Interactive Science] because they are more interesting fun. - Student*

- *The labs were much better this year, the workbook let us look back on everything we've done. - Student*

However, comparisons of students overall rating of the Labs in the Pearson Interactive Science program and the labs in the control programs showed significant results in favor of the control programs, $p<.05$, see Figure 68. While the labs in the control program had a more favorable rating than the labs in the treatment program there was still a very high percentage (82%) of students who agreed that they liked the labs in the PIS program. Students commented that the labs in Pearson Interactive Science program were fun and interesting and they liked how they tied to the books.

Figure 68. Treatment and Control Student Ratings of Labs included in Science Program
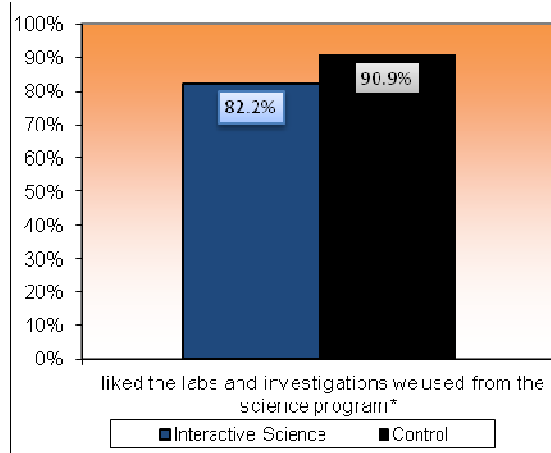
- *The PIS labs were fun, helped you learn and we did a lot of them. The old were boring, and we never did labs all that much. - Student*

- *The PIS labs helped you elaborate on the topic, also to understand how it can relate to life. - Student*

- *They tied in with the [Pearson Interactive Science] books and the directions were clear and easy to understand. - Student*

When treatment teachers were also specifically asked the extent to which they liked the labs from the Pearson Interactive

Science program, 65% agreed that they liked the labs. An analysis of qualitative data regarding the labs included in the PIS program revealed that while teachers liked the new ideas presented in the labs they found them to be time consuming, too long or difficult to set up or too simplistic. This was especially true of the Quick Labs and Inquiry Warm-Ups. In contrast, they felt the Lab Investigations were more worthy of their instructional time and adequately challenging for students.

- *The [PIS] labs were updated and asked questions that the students could relate back to their world and what is happening currently. - Teacher, Site AZ*

- *I learned a lot of new ways of presenting the material via the [PIS] labs. - Teacher, Site OH*

- *I liked some of the Inquiry Warm Up labs to get them thinking, some seemed to low, but it wasn't a bad way to get them thinking about it. - Teacher, Site AZ*

- *The Quick Labs are much lower than what they should be thinking wise. For the grade level they're too low. The lab investigations are much better and appropriate age wise; they get into it more. - Teacher, Site AZ*

- *Many of the labs, especially the Inquiry Warm Ups and the Quick Labs were not designed to be quick or to the point. A lot of time and energy went in to prepping something that was only to take 15 min. - Teacher, Site NY*

Scenario Based Investigations

Teachers were also asked to complete a Scenario Based Investigation activity during the school year as part of the study. Teacher surveys indicated that 70% of treatment teachers did complete the activity. The teachers that were unable to complete the activity stated time restraints as the reason for being unable to complete the activity. Of the teachers that did complete the Scenario Based Investigation they commented that they liked the real world aspect of it, the opportunity for students to apply all they had learned and the challenge it offered to high achieving students.

- *I liked the real world aspect of it [Scenario Based Investigation]. The kids felt like real scientists using "real" data and a possible scenario. I thought at first the kids might take too much time doing the investigation, but it was of appropriate length. Liked it. – Teacher, Site PA*

- *It [Scenario Based Investigation]was difficult for some students. My high achieving students loved the challenge. – Teacher, Site NY*

- *[With respect to Scenario Based Investigation] students were able to use what they learned in the chapter and apply to an*

activity that they enjoyed working on. – Teacher, Site OH

Technology

Both teachers and students agreed that they liked the technology component of the Pearson Interactive Science program. While there were a few teachers that rarely used technology due to the lack of technology resources in their schools and lack of comfort using technology, the teachers that used the digital component cited that they especially liked the ability to edit and print worksheets, lab worksheets and tests/quizzes. Teachers said that they were unable to assign student homework online due to their students' lack of technology resources at home. That said, the students that did access the online components found it useful to reinforce classroom instruction.

- *The kids enjoyed the set up of the book and they used the online material to help reinforce what we did in class. - Teacher, Site OH*

- *There are times I'm getting stuck in this rut and that's when I look at the digital path for other things to incorporate and I like that there's variety, that there's more than one way to handle the material. I like predictably and kids need to have that regimented, but they'll get bored if you do the same darn thing every time, so the fact that you have the three different paths to pick from is great. - Teacher, Site PA*

- *I think the digital path is fun to break up the monotony; I like the interactive art. - Teacher, Site AZ*

The majority of treatment students (84%) agreed that they liked it when their teachers used technology in class to deliver science instruction, see Figure 69. Students also commented that they liked the ability to do interactive assignments online and utilize the online Write-In Student Edition.

Figure 69. Student Ratings of the PIS Technology
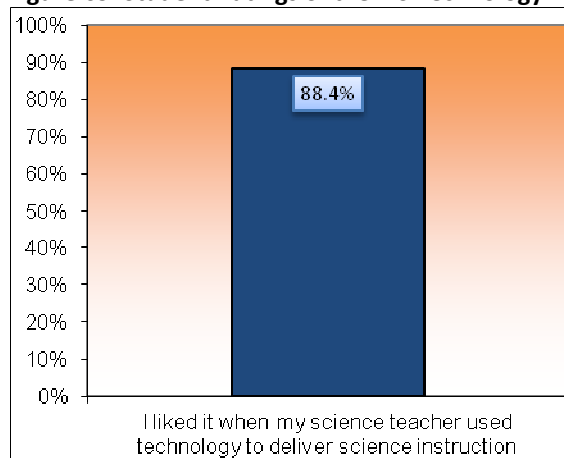
- *You get to work in the textbook and on the online textbook I can write notes and print pages out. - Student*

- *PIS helped me learn more because you were able to log on to computers to do interactive assignments. - Student*

Teachers who used the Pearson Online technology reported that they especially liked the ability to edit and print worksheets, lab worksheets and tests/quizzes. Students also liked having quick access to the online program.

In sum, teachers noted a variety of specific program components when asked to identify the three things they liked best

about the Pearson Interactive Science program. However, a few items emerged as favorites from many teachers, including:

- Write-In Student Edition
- Lab Activities
- Online Digital Path

Teachers reported that they really liked the Write-In Student Edition in that students could write in them and actively participate and interact with the text. Teachers also mentioned that they liked the student ownership aspect of the consumable Write-In Student Edition. Despite some critiques regarding the lab activities (e.g., some take too much time to complete and set up, are not meaningful, etc.) most of the teachers indicated that they liked the variety of labs available as well as the lab materials that were provided with the program. As well, a majority of teachers reported that they liked the Online Digital Path especially the ability to edit worksheets, labs and tests/quizzes.

While overall teachers liked the PIS program, they also had some very useful feedback about the program and potential areas for improvement. The primary area(s) that teachers noted as needing improvement were the labs included in the program, specifically the estimated timing of the lab activities. In particular, teachers reported that some of the labs (Quick Labs and Inquiry Warm-Ups) did not fully extend the concept and were not worth the amount of time and effort they took. Teachers commented that some of the labs did not fully extend the concept it was meant to and they were not worth the time it took to set up. Another comment regarding the lab resources included combining the lab resources book with the TE so these important resources were in one location. Other feedback on the PIS program included a more in depth Assess Your

Understanding, Study Guide, and extra pages for writing in the Write-In Student Edition. Finally, while most teachers felt that this program was appropriate for average- and low-performing students, some teachers noted that it was not challenging enough for higher-level students.

Conclusion

Results obtained from a one-year randomized control trial designed to look at the effects of the Pearson Interactive Science program on student learning show that the PIS program produced significant positive effects on student learning. Students who used Pearson Interactive Science as their core science curriculum over the course of one school year performed significantly better than control students as measured by the Developed Science test, and a marginally significant difference in favor of PIS students was observed on the *TerraNova* Science test as well. It should be noted that the former was more sensitive as it was more closely aligned to the science concepts covered during the school year.

Analysis of subtests showed that Pearson Interactive Science students performed better than students using other science programs (including both inquiry-based and traditional basal programs) in the areas of Scientific Inquiry, Science & Technology, and Life Science. Students using Pearson Interactive Science also showed higher levels of performance on the multiple-choice items, which primarily measured science facts and concepts, and fill in the blank items, which measured science vocabulary, within the Developed Science test. In sum, this research suggests that the positive effects associated with using Pearson Interactive Science may be due to its strength in promoting scientific inquiry (including critical thinking skills) as well as general scientific concepts and science vocabulary. It should also be emphasized that the consistency of positive effects in favor of Pearson Interactive Science across different assessment measures is noteworthy.

The small to moderate effect sizes obtained in this study (d=.33 to .46) would be considered meaningful in the educational research literature. These effect sizes translate to Pearson Interactive Science students being 18 percentiles higher than control students on the Developed Science test, and 13 percentiles higher on the TerraNova science test.

Positive changes were observed in other areas as well. For example, Pearson Interactive Science teachers reported being better prepared to teach various science content areas from Fall to Spring. Students using the Pearson Interactive Science felt that the Write-In Student Edition provided them with useful information to learn and understand science which was facilitated by the lab zones and visual representations. Teachers also noted that being able to write in the Student Editions helped with student engagement, learning, and a sense of pride in their work. Additionally, the vast majority of teachers and students felt that the Pearson Interactive Science program helped students make connections between science, real world applications, and other subject areas.

At the same time, other positive changes in student and teacher attitudinal outcomes were observed among control students and teachers. For example, students using other science programs felt more strongly about their science abilities and enjoyed science more as compared to students using Pearson Interactive Science. Furthermore, control students indicated that their science programs prepared them to do well in state/national tests and future science courses to a greater extent than treatment students. Control teachers also generally had higher perceptions about their programs' assistance with differentiated instruction, progress monitoring, lesson

preparation, and pacing as compared to teachers using Pearson Interactive Science.

Approximately 87.5% of treatment teachers and 80% of treatment students reported enjoying the Pearson Interactive Science program. The majority of teachers and students also reported that they would like to use the program during the following school year. Students and teachers felt the program was easy to understand, engaging and well-organized. Furthermore, when treatment teachers and students were asked to compare the Pearson Interactive Science program to their prior year's science program on various aspects (e.g., overall quality, labs, resources, organization, etc.), teachers and students generally rated the Pearson Interactive Science program as better than their prior program.

In sum, the data indicates that the Pearson Interactive Science program produces positive student outcomes in science. Teachers and students also enjoyed using the program. In addition, researchers were able to obtain information on how the program was used in real-world classrooms. Still, further research is needed to build upon the findings presented in this report. For example, the lack of subgroup effects does not mean that the program was not effective among subgroups of students or programs, but rather due to the limited sample size at the subgroups level, it is unclear whether Pearson Interactive Science has a positive impact among subpopulations. In addition, changes in attitudinal outcomes may take more time to realize as teachers become accustomed to the program and its resources. Nonetheless, the results from this RCT point toward a positive effect of the Pearson Interactive Science program on student science learning.

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Appendix A

Characteristics and WWC Review Standards

Table A1: Crosswalk between Study Design Characteristics and WWC Review Standards

WWC Standards	Study Characteristics	Reference
Randomization: Were participants placed into groups randomly?	Teachers or classes were randomly assigned to control and treatment groups within schools[29]. Classes within teachers were randomly assigned when there was no other teacher available within a school at the same grade level. Random assignment was conducted via SPSS Random Selection feature by PRES researcher.	Page 12
Baseline Equivalence: Were the groups comparable at baseline, or was incomparability addressed by the study authors and reflected in the effect size estimate?	Randomization was reasonably successful in producing equivalent treatment and control groups in terms of student and teacher background characteristics. Still, a few differences (pretest scores, grade distribution, student science anxiety, and teacher support) were observed and covariates were included in the multilevel models to statistically equate the two groups and to increase the power of these analyses. These are reflected in effect size estimates.	Pages 23-26
Differential Attrition: Is there a differential attrition problem that is not accounted for in the analysis?	Both measurement and dropout attrition was examined. ▪ There was no evidence for differential dropout attrition (less than 7%). ▪ There was differential measurement attrition with a higher proportion of treatment students not providing pretest data than control students. However, the proportion was relatively small (8.5%). In addition, no performance differences were observed between those who completed tests and those that did not by group.	Pages 24-25
Overall Attrition: Is there a severe overall attrition problem that is not accounted for in the analysis?	There was an overall attrition of 6.9% due to students leaving school or moving from a treatment class to a control class (or vice-versa). Note that this was part of the initial site selection criteria; in order to minimize attrition, historical mobility rates were examined and sites with high attrition rates were eliminated from consideration.	Pages 24-25
Disruption: Is there evidence of a changed expectancy/ novelty/disruption, a local history event, or any other intervention contaminants?	There was no evidence of changed disruption, or a local history event. Contamination among control group teachers was also not observed. Potential treatment contaminants included: 1) the less than desirable (low) implementation of the program by 2 treatment teachers (5 classes), and 2) the initial slow pacing of treatment teachers who were new to the Pearson Interactive Science program.	Pages 32-33

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[29] There are a number of reasons why random assignment to treatment conditions was done at the teacher/classroom level within schools. The most important reason for selecting this level of assignment is that such a design helps to establish causality by reducing the threat that school-level factors could have potentially contributed to differences between treatment and control groups. That is, school "A" might have had something else going on (besides the treatment) that may have influenced student performance on the outcome measures. Since treatment and control groups were within the same school, school-level explanations of differences were reduced. Another reason for within school assignment is that it is likely that the treatment and control groups will possess similar characteristics at the onset of the study and therefore enhance comparability. Third, one of the criteria put forth by WWC's Study Standards is that treatment and control groups need to be drawn from the same local pool. The definition of local pool provided in this study refers to subjects within the same classroom or school. According to the criteria, randomization at the district level would not be drawing people from the same local pool. Note, while this may increase the potential threat of contamination this was contained by an in-depth study orientation, monthly teacher logs, and site visits. Notably while random assignment at the teacher/classroom level within schools helps researchers control for school level differences as potential explanations of observed differences between treatment and control groups, teacher level factors can also be present and are important predictors of student performance (Gersten, Lloyd, & Baker, 1998). Though random assignment at the teacher/class level should help address this, with smaller sample sizes it is less likely that group equivalence will be ensured. In order to address this potential threat to initial group equivalence, additional data was collected on teacher background and classroom practices and examined and taken into account in interpretation of results.

WWC Standards	Study Characteristics	Reference
Intervention Fidelity: *1. Documentation*: Is the intervention described at a level of detail that would allow its replication by other implementers? *2. Fidelity*: Is there evidence that the intervention was implemented in a manner similar to the way it was defined?	**1. Documentation:** The implementation guidelines provided in Appendix B clearly outline the expectations for implementation of the program. The Pearson Interactive Science program is described herein in sufficient detail and references for further documentation from the publisher are available from their website at pearsonschool.com. **2. Fidelity:** Extensive procedures were put in place to measure fidelity of intervention including training, implementation guidelines, monthly teacher logs, and site visits. Overall fidelity of implementation can be characterized as moderate-high.	1. Appendix B 2. Pages 18-19
Outcome Measures: 1. *Reliability:* Is there evidence that the scores on the outcome measure were acceptably reliable? 2. *Alignment:* Is there evidence that the outcome measure was over aligned to the intervention?	**1. Reliability:** The assessments employed are reliable and valid. The reliability estimates for the assessments range from .89-.93. In addition, the publishers have further information on the validity of the TerraNova 3 test. **2. Alignment**: These tests measure science concepts and skills taught in typical middle school science classes. The content of the TerraNova reflects textbook series available from various publishers, curricula from most states, state and national science standards, and science literature. Similarly, the Developed Science test items were drawn from released state science assessments, TIMSS, NAEP, and in some instances custom-developed to measure content taught. In addition, the Developed Science test offer a broad coverage of content matter and consists of multiple-choice, fill in the blank, and short answer response options.	1. Pages 14-15 2. Pages 14-15
People, Settings, and Timing: 1. *Outcome Timing*: Does the study measure the outcome at a time appropriate for capturing the intervention's effect? 2. *Subgroup Variation*: Does the study include important variations in subgroups? 3. *Setting Variation:* Does the study include important variations in study settings? 4. *Outcome Variation:* Does the study include important variations in study outcomes?	**1. Outcome Timing:** In general, post measures were taken within 1 month of the end of the school. The one exception was School I which had to administer the posttest in March (2 months early) due to statewide testing late in the school year. Pretest measures were taken within 6 weeks of the start of the science class. **2. Subgroup Variation:** The sample includes variations in gender, race/ethnicity, science ability, free/reduced lunch status, and special education status. Analyses were conducted by all subgroups, although small sample sizes among some subgroups means that results should be interpreted with caution. **3. Setting Variation:** Sites were in suburban and urban settings and in 6 states across the US. All schools were public with an enrollment (303-1051 students) that is typical of schools at this level and in such settings (see Appendix C for site summaries). **4. Outcome Variation**: Five TerraNova content areas were used to measure the effect of the program on student performance. These included Life Science, Earth Science, Physical Science, Science & Technology, and Scientific Inquiry. The Developed Science test was also examined by the type of test item (multiple-choice, fill in the blank, and short answer). In addition, the impact of the program on student and teacher attitudes and classroom practices was also examined.	1. Page 19 2. Page 23 3. Pages 21-22 and Appendix C 4. Pages 14-15

WWC Causal Evidence Standards	Study Characteristics	Reference
Testing Within Subgroups: 1. *Analysis by Subgroup*: Can effects be estimated for important subgroups of participants? 2. *Analysis by Setting*: Can effects be estimated for important variations in settings? 3. *Analysis by Outcome Measures*: Can effects be estimated for important variations in outcomes? 4. *Analysis by Type of Implementation*: Can effects be estimated for important variations in the intervention?	**1. Analysis by Subgroup:** Effects were estimated via multilevel models for the subpopulations that we had sufficient data for (i.e., gender, ethnicity, science ability, etc.). Preliminary results showed no significant program effects for subgroups of students. **2. Analysis by Setting:** Preliminary analyses by setting consisted of examining program effects by program type. Preliminary results showed no significant program effects for type of program. **3. Analysis by Outcome Measures:** Effects were estimated for each subtest. **4. Analysis by Type of Implementation:** Effects were estimated by variations in implementation. Results showed no significant relationship between implementation levels and science performance.	1. Pages 45-49 2. Pages 45-49 3. Pages 45-49 4. Pages 43-44
Analysis: 1. *Statistical Independence*: Are the students statistically independent or, if there is dependence, can it be addressed in the analysis? 2. *Statistical Assumptions*: Are statistical assumptions necessary for analysis met? 3. *Precision of Estimate*: Is the sample large enough for sufficiently precise estimates of effects?	**1. Statistical Independence:** Analysis of the intraclass correlations showed that dependency was an issue among this sample of students. However, this was addressed by using hierarchical linear modeling and inclusion of cluster-level covariates. **2. Statistical Assumptions:** All underlying statistical assumptions were met. **3. Precision of Estimate:** Power analyses revealed that multilevel models have enough power to detect medium to large effects.	See Technical Report
Reporting: 1. *Complete Reporting*: Are findings reported for most of the important measured outcomes? 2. *Formula*: Can effects be estimated using the standard formula (or an algebraic equivalent)?	**1. Complete Reporting**: All main findings for the outcomes are presented in the Technical Report. **2. Formula:** All effect sizes (Hedge's g) for outcomes measures are calculated and presented in the report. The formula for calculating effect sizes of main program outcomes is presented in the Technical Report.	See Technical Report

Appendix B:

Pearson Interactive Science Implementation Guidelines

Pearson Interactive Science 2011 Randomized Control Trial (RCT) Implementation Guidelines

INTRODUCTION

Welcome and thank you for participating in the 2010-2011 randomized control trial being conducted by PRES Associates on the *Pearson Interactive Science 2011* program. We believe your experience with our study will be rewarding and enjoyable. Not only will you contribute to cutting-edge research, but you will also benefit from first-rate professional development provided by Pearson Education professional training specialists.

We understand that it may be challenging to change former practices and implement a new science program. Therefore, we greatly appreciate the time and effort you will contribute into making this study a success. However, we also realize that there may be obstacles and challenges as you begin to implement this program. Under these circumstances, we want and need to hear from you; we will guide you through those challenges. In fact, it is critical that any problems you encounter be addressed as soon as possible to ensure that this program is being implemented to its full potential. Feel free to contact PRES Associates via e-email at studies@presassociates.com if you have any questions, problems or concerns.

The following provides answers to some common questions teachers may have related to this study. Please read through all of these questions/answers. Again, should you have further questions, please contact PRES Associates.

WHY IS THIS RESEARCH BEING DONE?

As you are aware, the No Child Left Behind Act (NCLB) of 2001 requires that educational materials and strategies used by educators in the classroom *must be proven by scientific research to improve student achievement in the classroom*. Pearson Education has developed a strong research model for determining that their programs are scientifically-based. As part of this research agenda, Pearson Education has contracted with PRES Associates[30], an external educational research firm, to conduct a randomized control trial (RCT) focused on a rigorous evaluation the effectiveness of the Pearson *Interactive Science 2011* program in helping middle school students (grades 6-8) attain critical science skills.

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[30] PRES Associates is an external, independent, educational research firm with an established track record in conducting large-scale, rigorous evaluations on the effectiveness of research materials.

WHY DO I NEED PROFESSIONAL DEVELOPMENT?

It takes more than a good curricular program to raise students' knowledge of science. It also takes good teachers with a thorough understanding of the curriculum, who are supported by professional development, school administrators, and parents/guardians. To this end, it is hoped that through the professional development training session provided by Pearson Education on the use of its science program, all teachers participating in the study will gain the knowledge and skills to successfully implement this program right from the start.

As you will soon learn, this science program provides numerous teaching resources and supports. In order to implement this program successfully, it is essential that teachers have a thorough understanding of the resources provided by the *Pearson Interactive Science 2011* program. Rather than having teachers figure it out on their own, professional trainers will guide you through this process, offering examples of when to use certain materials, how to manage and supplement classroom instruction, what types of assessments to administer, and so forth.

WHY DO I NEED TO FOLLOW THESE IMPLEMENTATION GUIDELINES?

The Teacher Implementation Guidelines were developed as part of the *Pearson Interactive Science 2011* RCT. The guidelines are designed for teachers to use when implementing the new program in their class(es). The guidelines point out key program components that *must* be implemented during science lessons. These key program components have the greatest influence on student learning and performance, and therefore should be implemented. In addition, it is critical to ensure that all teachers are implementing a similar instructional model. That is, if teachers are modifying the program to an extent that it no longer resembles the original program, the study will not provide accurate information reflective of the *Pearson Interactive Science 2011* program. In sum, by providing these implementation guidelines, we are attempting to (1) maximize the potential of this science program to help your students, and (2) ensure that the program is being implemented with fidelity across all teachers using the program. To reiterate, *it is essential that all teachers using the program fully apply the following implementation guidelines as prescribed.* That being said, there are optional parts to the program as well as ancillary materials that provide you with the flexibility you need to address unique student needs or contexts. *We trust your professional judgment and ask that you try to implement the program as best you possibly can while meeting your students' instructional needs.*

Again, thank you for your participation in this study. You are an integral part of this study and we appreciate your assistance. We look forward to working with you.

Pearson Interactive Science 2011

IMPLEMENTATION GUIDELINES

Organization of the Program

Pearson Interactive Science 2011 program is an inquiry-based instructional methodology organized around the **5Es**:
1) engage
2) explore
3) explain
4) extend
5) evaluate

The program is designed to be used by teachers with varying levels of comfort with an inquiry-based model of instruction. Teachers less comfortable with inquiry-based learning can use the text as an instructional guide, whereas teachers more comfortable with inquiry-based learning can use more self-directed instruction through hands-on labs and student independent reading on topics. The lessons are organized so that step-by-step movement through the lesson ensures that each of the **5E**s is engaged during student learning.

Understanding by Design is an organizational strategy that puts the big ideas of science into kid-friendly, big-picture questions about science. Each chapter poses a big-picture question designed to engage student in the upcoming material. Within each lesson, framework questions are posed to organize the presentation of material. These questions are aligned so that coverage of the associated material will help 'unlock' the answer to the Big Question.

Write-in student editions contain all of the rich content of a textbook combined interactivities to enhance student engagement and comprehension designed to enable students to read, write, draw, graph, apply, and assess all between the covers of a single book. Utilization of the various features or sections of the write-in student edition (Assess Your Understanding, Apply It!, Lab Zone, etc.) will ensure that instruction is framed around the 5Es, and will institute an inquiry-based mode of instruction.

In addition to print materials, the digital path contains e-text versions of both the Teachers' and Student Editions and is designed to enhance classroom activities and classroom participation of the various Write-In Student Edition activities. The components of the digital path are organized around the 5E's and include the same activities that are embedded within the Write-In Student Edition. The teacher resources embedded in the digital path will also assist in various classroom management activities such as lesson planning, customizing quizzes and exams, and assigning student work. The teachers' resources within the digital path will also allow teachers to access editable worksheets and lab resource activity sheets for easy customization.

Materials

Please note that you will have a variety of materials to draw from as you implement the *Pearson Interactive Science 2011* program. We do not expect you to use every lab activity or hands-on activity, but we ask that you incorporate each program component into your classes when feasible, including student completion of the Write-In Student Edition, use of labs, and the digital path. Within each lesson, your Teacher's Edition (TE) Write-In Student Edition will reference the Lab Zones, Animations, and activities when appropriate for use.

Pacing

Each *Pearson Interactive Science 2011* module is organized into chapters that are further organized into lessons. Each chapter focuses on an overall content area; each lesson within a chapter breaks down the larger content area into instructional units.

Typically, there are 5 chapters per module and there are 4 lessons per chapter, with each lesson requiring approximately 3 days of instructional time. Thus, a chapter should be covered in approximately 15 days (or 3 weeks), which includes an additional 2-3 days for a chapter project, review of content, and assessment. Each module has about 5 chapters so overall it is estimated that one module should take about **15** weeks (or 3 ½ months) to complete.

Preparing to Teach the Topic & Lesson

1. Be sure to review all of the material in the Teacher Edition (TE) Write-In Student Edition, **Lab Zone** kits, and **Scenario-Based Investigations** aligned with the upcoming lesson. Pay particular attention to the Big Questions and Lab Zones to see how you can incorporate hands-on learning into your instruction, and how the activities relate to the overall theme of the chapter and lesson. Also review the **Apply It!** and **Assess Your Understanding** sections to understand when these informal assessments will occur. **Assess Your Understanding** sections can be printed out, administered, and collected for ease of use.

2. Pay particular attention to upcoming **Animation** activities in the Write-In Student Edition, and **Lab Zones**, to ensure quick and efficient implementation of these activities during class.

Teaching the Topic & Lesson

Chapter Opener: The Big Question is the big-picture, Understand By Design question that is designed to engage students in the upcoming work of the lessons. This question serves as the over-arching theme for the entire chapter, and each lesson is designed to present the content necessary to 'unlock' the answer to the Big Question.

- Untamed Science Videos -- engaging videos that bring to life a key concept from each chapter
- Check for Understanding – ask students to check their own understanding by completing the short assessment at the beginning of each chapter

- Vocabulary Skill – helps students compare every day meaning of important vocabulary to scientific meanings
- Chapter Preview presents the skills and vocabulary to be learned, organized by lessons. This should be reviewed with your students

Lessons: Questions aligned to the overall chapter Big Question are presented to organize the content of the lesson. In support of these questions, instructional content is presented to students in text and picture form. Embedded in the Write-In Student Edition around the primary text content are various sub-sections aligned to the **5E**s:

ENGAGE
- ➔ The Big Question – Introduce the Big Question at the beginning of a new topic and reference the Big Question throughout the chapter. Assign the Explore the Big Question activity sections in the Write-In Student Edition
    - o Untamed Science Videos **–** Have students watch the **Untamed Science videos within the digital path and answer the questions** following the videos
- ➔ Check Your Understanding – Have students complete the Check Your Understanding sections of the chapter
- ➔ My Planet Diary – Begin each lesson with My Planet Diary

EXPLORE
- ➔ Inquiry Warm-Up Lab – **We ask that you complete the Inquiry Warm-Up Lab in EACH lesson.** Labs are used as an introduction to an upcoming lesson or chapter.
- ➔ *After the Inquiry Warm-Up* worksheet (*optional*) – Use the After Inquiry Warm-Up worksheet to show what students learned

EXPLAIN
- ➔ Vocabulary – review vocabulary section of Write-In Student Edition
- ➔ Figures/Activity Art/Animations – use these to reinforce instruction
- ➔ Key Concept Summaries (o*ptional*)
- ➔ 21st Century Skills (*optional*) – Use 21st Century Skills section of your TE to reinforce these skills
- ➔ Differentiated Instruction (*optional*) – use the Differentiated Instruction activities noted in your TE

ELABORATE
- ➔ Apply It! – Assign the Apply It! Activity sections in the Write-In Student Edition
- ➔ Quick Lab – **Complete 1 Quick Lab per lesson** (Note: there may be multiple labs per lesson, please select one per lesson).
- ➔ Do the Math! – Assign Do the Math! Activity sections in the Write-In Student Edition
- ➔ Lab Investigation – **Complete 1 Lab Investigation per chapter**

EVALUATE
- ➔ Assess Your Understanding – Review answers to Assess Your Understanding sections of the Write-In Student Edition
- ➔ Study Guide (*optional*)

Scenario Based Investigations

The Scenario Based Investigations ancillary book contains various engaging activities that allow students to apply their knowledge to investigate the chapter concepts in the *Interactive Science* program. There are approximately 4-7 investigation activities available for each module that can be used to reinforce inquiry, real-world application and cooperative learning in the classroom. Because we are interested in getting as much feedback on the program from Teachers, we ask that you complete one activity available in the Scenario-Based Investigations book.

Reorganizing the Program

The chapters within each module available for instruction during the pilot of the *Pearson Interactive Science 2011* program can be taught in any order. However, lessons within each chapter should be covered in the order in which they are organized, with each lesson providing content and inquiry-based learning in support of the chapter Big Questions. The TE will alert the teacher when it is the appropriate time to incorporate labs or other hands-on activities into lessons.

SOME FINAL THINGS TO REMEMBER

- ➢ Remember that a chapter lesson should take approximately 2-3 days to cover. Be sure to incorporate at least **1** Inquiry Warm Up Lab and **1** Quick Lab per lesson, while maintaining a 3-day pace per lesson. Also, be sure to complete **1** Lab Investigation per chapter and **1** Scenario Based Investigation during the school year. The labs and other applied activities are the key to engaging students in learning.
- ➢ Please note that the *Pearson Interactive Science 2011* program is designed to "have it all" and teachers should not need to go to other sources for their problems or activities. In fact, ***the activities and problems included in the Pearson Interactive Science 2011 program have a clear rationale and thought process behind them and therefore are considered essential to the program***. While it is sometimes common that teachers substitute their own activities instead of using the ones included in a program, **we ask that you use the activities and problems included in the program** and do not substitute them during the pilot study.
- ➢ Following the lessons as outlined, and making use of the various hands-on activities and labs ensures that you are instructing in a way that models the **5E**s and an inquiry-based instructional process capable of engaging students in higher-order learning.
- ➢ It is important that students complete and use the SE in their entirety, including the **Check Your Understanding** sections at the beginning of each chapter and the **Assess Your Understanding** and **Apply It!** sections embedded throughout the lessons. These Write-In Student Editions serve as a record or journal of their learning throughout the chapters.
- ➢ While the utilization of the various digital path components is not mandatory, we ask that for the purposes of feedback on the program, the digital path activities be incorporated the in the classroom to the extent that they are feasible.

Appendix C:

Case Study of Site Visits

School A (AZ)

About the School: School A is a public school located in an upper middle class, suburban community in Arizona. The school consists of a newer well-kept building. The school houses students in grades 7-8. During the 2010-2011 school year, enrollment at School A was 820, with a student to teacher ratio of 19 to 1.

In 2010, Arizona used the Arizona's Instrument to Measure Standards (AIMS) to test students in grades 4 and 8 in science. The tests are standards-based, which means they measure student proficiency of the Arizona Academic Content Standards. Results show that 77% of 8th grade students at School A were proficient in science, which is higher than the state average of 58%. The student population is predominantly White:

- 87% White
- 9% Hispanic
- 2% Asian/Pacific Islander
- 1% Black
- <1% American Indian/Alaskan Native

Approximately 7% of the students at the school were eligible for free or reduced-price lunches, and <1% were classified as Limited English Proficient.

Study Participants: Five teachers participated in the study: three treatment teachers and two control. At the 7th grade level, two teachers were assigned to the treatment condition and one had three class periods and the other had one class period (4 treatment classes total); one teacher was assigned to the control condition and taught three class periods. At the 8th grade level, there were two treatment teachers with the first teacher teaching three class periods and the other teaching two class periods (5 treatment classes total); one control teacher taught three class periods. Thus, there were 15 participating study classes. The 15 classes contained approximately 524 students, with an average class size of 35, and a range of 30 to 38.

For the most part teachers characterized their classes as average, with some high performing and low performing students, with a couple exceptions. The 7th grade control teacher indicated one of her classes tended to be more lower performing than her other classes. Overall all other classes were noted as typical of the student population.

Science Curriculum and Resources: The 7th and 8th grade control program consisted of a 2005 middle grades science textbook. In general, the teachers used this basal program as the main science curriculum though they supplemented the program occasionally where needed. There were a few similarities between the control program used and the Pearson Interactive Science program. Similarities included opportunities for hands-on explorations and math activities included in the program. Both programs also include connections to other subject areas (e.g., Math and Language Arts) and opportunities for review and assessment. In general the Pearson Interactive Science program focused more on big ideas and overarching themes and in general

required students to think and write about science (e.g., within Write-In Student Edition) more regularly than did the control program.

In treatment classes, the teachers were observed following the Pearson Interactive Science program exclusively and somewhat adhering to the implementation guidelines. The treatment teachers experienced difficulties completing all the required components of the implementation guidelines in the first half of the year and opted to complete the components of their choosing in the second half of the year. While teachers did not supplement with any published program teacher created lab activities and worksheets were supplemented as needed, and labs and Untamed Science Videos were used with less frequency.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teacher only taught science). Classes lasted for 60 minute periods and occurred every day during the same time for the duration of the year. All students had sufficient copies of student science textbooks.

Science instruction in the control classroom was relatively consistent. The teachers would usually spend the first 5 minutes doing a warm-up then review the days objectives. In the 8th grade this oftentimes included questions about lab safety rules and the metric system. For the next 20-30 minutes the teacher would teach the lesson by lecturing with discussion or reading the science text. The teachers noted that class discussions were typically student led rather than teacher led. Students also were directed to write notes during the reading or lecture. On days in which a lab inquiry based activity would occur (about once or twice a week) this would follow the warm up activity. The remainder of class was spent wrapping up the lesson. The 7th grade control teacher indicated that she was more likely than the 8th grade teacher to assign independent work such as reading the text and answering questions. In the 7th grade class anything not finished would be assigned as homework and this usually occurred 3 times per week. In the 8th grade class homework was rarely assigned except for large unit project activities.

Lessons in the treatment classrooms were varied slightly in structure to the control class. Lessons started with an introduction to vocabulary in the lesson. Next teachers would complete the My Planet Diary and if selected, an Inquiry Warm Up lab was used as a warm up activity. The teachers would then assign the students to read the lesson text directing students to complete Write-In Student Edition activities as they appeared in the student edition (e.g., Assess Your Understanding, Do the Math, etc.). These were typically completed independently, with the teacher checking student work. Other in-class independent practice typically consisted of lesson quizzes and Review & Reinforce worksheets. Homework was not assigned. On occasion, Quick Labs and Lab Investigations were also completed. The teachers would finish the lesson with a review of the lesson to reinforce key concepts. Unfinished independent class work such as Write-In Student Edition activities and worksheets was assigned as homework.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking homework, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment.

For treatment students, the teacher used Pearson program materials such as Lesson Quiz, Chapter Tests, and custom tests from ExamView. For control classes, the teachers modified test questions included in the control program and created their own tests. In the 8th grade the teacher also included practice items from the AIMS test and had students complete larger unit projects.

Comparability: In terms of overall comparability, both the Pearson Interactive Science and the control classrooms were similar. For example, science vocabulary, labs and inquiry activities were presented in both treatment and control classes and students in both treatment and control were taught the same concepts, although the sequence and materials used were different. There were some disparities in the amount of independent in class practice that students engaged in, specifically treatment students had more practice opportunities given the interactivities presented in the Pearson program than did their control counterparts. Among the participating teacher's classes, no contamination was noted and student engagement and interest was average.

School B (AZ)

About the School: School B is a public school located in an upper middle class, suburban community in Arizona. The school consists of a newer well-kept building. The school houses students in grades K-6. It was noted that this was a transitional year as it was the first year in which 6th grade students attended school in this building. The 6th graders previously attended school in the middle school building. During the 2010-2011 school year, enrollment at School B was 660, with a student to teacher ratio of 16 to 1.

In 2010, Arizona used the Arizona's Instrument to Measure Standards (AIMS) to test students in grades 4 and 8 in science. The tests are standards-based, which means they measure student proficiency of the Arizona Academic Content Standards. Results show that 92% of 4th grade students at School C were proficient in science, which is higher than the state average of 61%. The student population is predominantly White:

- 88% White
- 8% Hispanic
- 2% Asian/Pacific Islander
- 2% Unspecified

Approximately 5% of the students at the school were eligible for free or reduced-price lunches, and 2% were classified as Limited English Proficient.

Study Participants: One teacher participated in the study and taught both treatment and control classes. This teacher taught 6th grade only with two treatment classes and one control class. Thus, there were 3 participating study classes. The 3 classes contained approximately 82 students, with an average class size of 27, and a range of 26 to 29.

For the most part the teacher characterized his classes as average, with some high performing and low performing students. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The 6th grade control program consisted of a 2004 middle grades science program. In general, the teacher used this inquiry based program as the main science curriculum and supplemented some sections using a 2005 middle grades science basal program. There were a few similarities between the control program used and the Pearson Interactive Science program. Similarities included opportunities for hands-on explorations and multimedia activities woven into instruction. Both programs provide an emphasis on hands on inquiry activities and encourage students to make real world connections. The supplemental program also included opportunities for hands on inquiry as well as emphasis on vocabulary and other academic subjects. It should be noted that this control program is heavily investigative with lessons organized around a full length lab activity whereas the Pearson Interactive Science Program focused more on directed instruction with opportunities hands on experiences.

In treatment classes, the teacher was observed following the Pearson Interactive Science program exclusively and mostly adhering to the implementation guidelines. The science classrooms were not equipped with traditional lab stations (no heat or water source) so lab activities tended to be difficult to set up and messy. However the teacher stated that he did his best to include all the required lab activities.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teacher only taught science). Classes lasted for 85 minute periods and occurred every day during the same time during second semester. For the reminder of the year students received instruction in social studies. It should be noted that the block scheduling of the science classes allowed for a full year's science content to be taught in one semester. All students had sufficient copies of student science textbooks.

Science instruction in the control classroom was relatively consistent. The teacher would usually spend the first 5 minutes doing a warm-up, which oftentimes included an engaging question. For the next 30-40 minutes the teacher would have the students complete the lab activity included in the control program lesson. Then the teacher would have the students read the lesson text in the book as a group. During the reading, the teacher would stop and ask questions related to the material they had read, elaborating on concepts as needed. Students also were directed to write notes. The main lesson was followed by answering questions in the book which sometimes included pairs/small group work. Homework was assigned about once a week and generally included any in class work that was not finished.

Lessons in the treatment classroom differed in structure to the control class. Lessons started with the brief warm up activity while the teacher took attendance. Depending on where they were within a module, they would introduce the lesson/chapter with Getting Started or My Planet Diary. The lesson text was read aloud by the students (round robin). As directed within the TE, the teacher would stop to ask questions and encourage discussion. The teacher also made sure students completed the majority of Write-In Student Edition activities as they appeared in the book. These were typically completed independently, then returning to whole group to review and discuss everyone's findings. This was typically supplemented with the digital path activities included in the PIS program projected onto the SmartBoard. Other in-class independent practice typically consisted of lesson quizzes, and Review & Reinforce worksheets. A lesson was

completed by spending 10-15 minutes conducting a hands on activity from the PIS program. Homework was assigned about once a week and generally included any in class work that was not finished.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking assignments, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teacher used Pearson program materials such as Lesson Quiz, Chapter Tests, and custom tests from ExamView. For control classes, the teacher used assessments from the control program. However, the teacher also stated that he had treatment students complete some of the un-used Lab Investigations as chapter projects for an in-class presentation.

Comparability: In terms of overall comparability, both the Pearson Interactive Science and the control classrooms differed slightly. For example, the control program was an inquiry based program that emphasized hands on activities over traditional textbook activities. While the Pearson Interactive Science program included various opportunities for hands on science inquiry, the program still contains aspects of a basal program. Both treatment and control programs however, emphasized real world connections and opportunities to incorporate technology and students in both treatment and control were taught the same concepts, although the sequence and materials used were different. There were some disparities in the amount of note taking activities that occurred as control students wrote notes in a science journal, while treatment students kept their notes within the Write-In Student Edition. Despite the teacher teaching both treatment and control classes, no contamination was noted and student engagement and interest was average.

School C (AZ)

About the School: School C is a public school located in an upper middle class, suburban community in Arizona. The school consists of a newer well-kept building. The school houses students in grades K-6. It was noted that this was a transitional year as it was the first year in which 6th grade students attended school in this building. The 6th graders previously attended school in the middle school building. During the 2010-2011 school year, enrollment at School C was 660, with a student to teacher ratio of 17 to 1.

In 2010, Arizona used the Arizona's Instrument to Measure Standards (AIMS) to test students in grades 4 and 8 in science. The tests are standards-based, which means they measure student proficiency of the Arizona Academic Content Standards. Results show that 79% of 4th grade students at School C were proficient in science, which is higher than the state average of 61%. The student population is predominantly White:

- 90% White
- 8% Hispanic
- 2% Unspecified

Approximately 6% of the students at the school were eligible for free or reduced-price lunches, and 3% were classified as Limited English Proficient.

Study Participants: One teacher participated in the study and taught both treatment and control classes. This teacher taught 6th grade only with one treatment classes and one control class. Thus, there were 2 participating study classes. The 2 classes contained approximately 65 students, with an average class size of 33, and a range of 32 to 33.

For the most part the teacher characterized the classes as average, with some high performing and low performing students. It was however noted that the control class period contained more high performing students than the treatment class which contained mostly average students. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The 6th grade control program consisted of a 2004 middle grades science program. In general, the teacher used this inquiry based program as the main science curriculum (same as that used at School B). There were a few similarities between the control program used and the Pearson Interactive Science program. Similarities included opportunities for hands-on explorations and multimedia activities woven into instruction, and both programs provide and emphasize hands on inquiry activities and encourage students to make real world connections. It should be noted that this control program is heavily investigative with lessons organized around a full length lab activity whereas the Pearson Interactive Science Program focused more on directed instruction with opportunities hands on experiences.

In treatment classes, the teacher was observed following the Pearson Interactive Science program exclusively and mostly adhering to the implementation guidelines. The science classrooms were not equipped with traditional lab stations (no heat or water source) so lab activities tended to be difficult to set up and messy. The teacher stated that she had difficulties getting started with the program and fell behind in instruction. Therefore she was unable to complete all the required labs but stated that at least one occurred for every lesson.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teacher only taught science). Classes lasted for 85 minute periods and occurred every day during the same time during second and third quarter. For the reminder of the year students received instruction in social studies. It should be noted that the block scheduling of the science classes allowed for a full year's science content to be taught in one semester. All students had sufficient copies of student science textbooks.

With the control class, the teacher would usually spend the first 5 minutes doing a warm-up, which oftentimes included an engaging question. For the next 30-40 minutes the teacher would have the students complete the lab activity included in the control program lesson. Then the teacher would have the students read the lesson text in the book as a group. During the reading, the teacher would stop and ask questions related to the material they had read, elaborating on concepts as needed and directing students when to write notes. The main lesson was followed by

answering questions in the book which sometimes included pairs/small group work. Homework was very rarely assigned in the control class.

Lessons in the treatment classroom differed in structure to the control class. Lessons started with students reading their Write-In Student Edition as a group. The lesson text was read aloud by the students (round robin). It was noted that sometimes this was supplemented with the digital path activities. Next the teacher would have the students complete a lab or interactivity included in the PIS program. Occasionally the teacher would set up the lab activities as stations where students would move from station to station to complete multiple activities at once. The lesson would end with students completing an independent activity such as the Lesson Quiz or a Review & Reinforce worksheet. Homework was also very rarely assigned.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking assignments, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teacher used Pearson program materials such as Lesson Quiz, Chapter Tests, and custom tests from ExamView. For control classes, the teacher used assessments from the control program.

Comparability: In terms of overall comparability, both the Pearson Interactive Science and the control classrooms differed slightly. For example, the control program was an inquiry based program that emphasized hands on activities over traditional textbook activities. Both treatment and control programs however, emphasized real world connections and opportunities to incorporate technology and students in both treatment and control were taught the same concepts, although the sequence and materials used were different. There were some disparities in the amount of note taking activities that occurred as control students wrote notes in a science journal, while treatment students kept their notes within the Write-In Student Edition. Among the participating teacher's classes, no contamination was noted and student engagement and interest was average.

School D (KY)

About the School: School D is a public school located in a lower middle class, suburban community in Kentucky. The school consists of an older building that while clean was in need of renovations. The school houses students in grades 6-8. During the 2010-2011 school year, enrollment at School D was 669, with a student to teacher ratio of 17 to 1.

In 2010, Kentucky used the Kentucky Core Content Tests (KCCT) to test students in grades 4 and 7 in science. The KCCT, composed of open response items and multiple choice questions, is given each spring to students and assesses student mastery of the Kentucky Core Content for Assessment, as well as higher order thinking and communication skills. Results show that 55% of 7th grade students at School D were proficient or distinguished in science, which is lower than the state average of 62%. The student population is predominantly white:

- 61% White
- 4% Hispanic
- 34% Black
- 1% Asian/Pacific Islander
- <1% American Indian/Alaskan Native

Approximately 49% of the students at the school were eligible for free or reduced-price lunches, and less than 1% of the students were classified as Limited English Proficient.

Study Participants: Two teachers participated in the study: one treatment teacher and one control. Both teachers were at the 8th grade level. The treatment teacher taught two class periods and the control teacher taught two class periods. Thus, there were 4 participating study classes. The 4 classes contained approximately 99 students, with an average class size of 25, and a range of 11 to 37.

For the most part teachers characterized their classes as average, with some high performing and low performing students, with a couple exceptions. The 8th grade treatment teacher reported that one class contained mostly gifted students with some average students as compared to other 8th grade classes. The control teacher reported that one of the classes, while considered average tended to be lower performing overall as compared to other classes. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The control teacher did not have any one science program available. Therefore, the control teacher used only teacher and district created resources. This included teacher-created lessons, including worksheets and PowerPoints, as well as resources found on the internet (e.g., Discovery Education) or other published materials. Thus, the control teacher did not use any specific program but rather followed the district's science curriculum pacing guide and drew upon existing materials from a variety of sources to teach towards the Kentucky state science standards.

The control program used by the control teacher in School D was significantly different from the Pearson Interactive Science program in the variety of resources and structured science content of the new program. While the teachers followed a district curriculum map teaching similar content areas, the PIS program provided a more in-depth, structured, predictable lesson that the control program did not. Additionally each student in the treatment classes was provided a Write-In Student Edition to use when studying for tests and quizzes, while control students had to rely solely on their notes for studying purposes. However, there were a few similarities between the control program and the PIS program. Similar to the PIS program the control teacher focused on hands-on lab activities and developing inquiry skill concepts. Additionally both treatment and control teachers used technology regularly to demonstrate and reinforce important science concepts.

As noted, a district pacing guide was in place and the treatment teacher indicated that it was followed closely. In treatment classes, the teacher was observed following the Pearson Interactive Science program and adhering to the implementation guidelines. The treatment

teacher did note that while some labs were difficult to complete due to the lack of "sciencey" materials and infrastructure at the school, she did her best to complete the required 1 Inquiry Warm Up and 1 Quick Lab per lesson and 1 Lab Investigation per chapter. The treatment teacher commented that she did not supplement the material in any way during the study.

Instructional Practices and Strategies: Science instruction occurred throughout the day depending on the teacher. Classes lasted for 50-minute blocks and occurred every day during the same time.

Science instruction in control classrooms was relatively consistent. Overall the teacher would begin instruction with a bell ringer question to be completed independently. Teachers then reviewed the bell work and collected any homework prior to commencing the lesson. The lesson was generally done whole group. The teacher would begin the lesson using Powerpoints or an overhead to deliver lessons to facilitate note-taking. Some lessons also consisted of videos demonstrating a science concept or teacher demonstrations. After the lecture/notes students would complete an activity, typically in groups. At the close of the main lesson, the control teacher would have students share the results and discuss the group activity and provide independent practice (e.g., worksheets) so that students could apply what they had learned. Labs were also completed and typically lasted the entire class period. Labs typically occurred every couple of weeks and were typically teacher created and were generally teacher-directed.

In the treatment classrooms the structure of the lessons were dependent on where teachers were at in the Pearson Interactive Science module, or if they were doing a lab. A typical lesson day started with the teacher assigning a bell ringer activity. The activity varied but typically involved doing an activity related to the vocabulary included in the program. The teacher then reviewed the bell work and provided a brief lesson review of previously learned concepts that related to the days lesson. Next the teacher would introduce the Big Question discussing the main ideas and key concepts of the lesson. The teacher would incorporate technology in the lesson using the SmartBoard to display the digital Student Edition or digital path activities. The use of technology was done to get students engaged and thinking about the concepts they would be learning. Following the TE, the teacher would follow the prompts and questions included in the TE in order to exercise higher-level thinking and reasoning skills, and would encourage students to provide real life examples related to the concept. The teacher would also have students complete Write-In Student Edition activities as they appeared in the student book. As they progressed through the lesson the teacher would pause for a lesson check to have students discuss the progressing main idea of the lesson. Generally unfinished book work went as homework. On lab days, the teacher would generally project the accompanying worksheet for the Quick Lab, Inquiry Warm-Up, or Lab Investigation onto the SmartBoard and read the directions to the students. In general, the teacher would guide students as they completed the lab, so that it was teacher-led as opposed to student-led. Of note, is that some labs were difficult to complete due to the lack of resources and infrastructure in the school but the teacher was able to complete a lab activity at least 3 times a week.

Homework was somewhat consistent between treatment and control classes, with the exception that they used different materials. All teachers (both treatment and control) only assigned unfinished classroom activities as homework. For the control teacher, homework generally

consisted of completing teacher-created materials. Among treatment classes, homework also consisted of unfinished book work in the Interactive Write-In Student Edition.

Assessment: In terms of assessment, treatment and control teachers gave chapter tests and lesson quizzes. The control teacher gave a quiz every Friday which included the questions used during the bell ringer activities that week. A unit test was given whenever the teacher felt the students had mastered the topic. The treatment teacher administered chapter tests using the ExamView test generator and questions from the resource books included in the program. Informal assessment occurred every couple of days in which the teacher asked students to explain what they have learned from the lesson. Informal assessments occurred in all classrooms (e.g., observations, discussions, checking work etc.).

Comparability: In terms of comparability, both the Pearson Interactive Science and the control classrooms, with the exception of the program-based activities, were similar overall. As the teachers had to follow the district pacing guide, teachers covered similar content while using different materials to do so. However, as commented, the control teacher taught concepts "an inch deep and a mile wide" the treatment teacher taught concepts "a mile deep and an inch wide" as the Interactive Science program was far more detailed and in depth than the control program. Labs were completed much more frequently in the treatment class versus the control class as the treatment teacher indicated they were completed about 3 times a week and the control teacher only completed labs every 2-3 weeks. Both types of classes also incorporated the use of technology to engage students and demonstrate science concepts. In addition, no contamination was noted.

School E (NV)

About the School: School E is public K-12 charter school located in an urban neighborhood in Nevada. The school is housed in older buildings, with separate buildings for elementary and secondary grade levels. The science classrooms are at the limits of occupant capacity and have limited technological capabilities. During the 2009-2010 school year enrollment at School E was 640, with a student to teacher ratio of 22 to 1.

In 2009, Nevada used the Criterion Referenced Test (CRT) to test students in grades 5 and 8 in science. The CRT is a standards-based test, which means it measures specific skills defined for each grade by the state of Nevada. Results show out of the 8th grade students at School E who took the CRT science test, 33% were proficient which is lower than the state average of 66%. The student population is predominantly Hispanic:

- 21.7% White
- 56.2% Hispanic
- 18% African American
- 3.4% Asian/Pacific Islander
- 1% American Indian/Alaskan Native

No data was available regarding number of students noted as Limited English Proficiency or eligible for free or reduced-price lunches.

Study Participants: Originally, there were two science teachers at School E: one 6th grade science teacher and one 7th/8th grade science teacher. However, as a result of several turnovers and lack of consistent use of the Pearson Interactive Science program in the 6th grade classrooms, this grade level was dropped from the study[31]. In total there were five participating 7th and 8th grade study classes: one control and two treatment at the 7th grade, and one treatment and one control at the 8th grade level. The five classes contained approximately 109 students, with an average class size of 22, and a range of 20 to 24. Most of the classes in the study were of average to low level, that is they were comprised of middle and low performing students. Classes in the study were representative of the general student population.

Technology was not emphasized due to lack of technological resources and capabilities. Some attempts to incorporate technology were evident in the form of watching Untamed Science videos in treatment classes, but other than these infrequent occurrences, technology use was at a minimum.

Science Curriculum and Resources: The 8th grade control program consisted of a 2001 middle grades science textbook. In general, the teacher used this basal program as the main science curriculum though some modifications were made to adhere to the school's curriculum map. There were a few similarities between the control program used and the Pearson Interactive Science program. Similarities included opportunities for hands-on explorations and built-in lesson checks throughout the lesson and at the end. Both programs also include connections to other subject areas (e.g., Math and Language Arts) and encourage students to think and write about science. In general the Pearson Interactive Science program focused more on big ideas and overarching themes and in general required students to think and write about science (e.g., within Write-In Student Edition) more regularly than did the control program.

The 7th grade control program also consisted of a 2001 middle grades science textbook. This basal science program was from a different publishing company than the 8th grade program, and was the primary curriculum used by the teacher for her control class. Similar to the Pearson Interactive Science program, the program clearly identifies objectives and vocabulary at the beginning of each lesson. Other similarities include an engaging chapter opener, science-related feature articles, connections to other subject areas, and quick labs. However, the Pearson Interactive Science program allows for greater application of skills (e.g., Do the Math, Apply It), and critical thinking and practice opportunities via the interactivities in the Write-In Student Edition.

In treatment classes, the teacher was observed following the Pearson Interactive Science program exclusively and mostly adhering to the implementation guidelines, with the exception of not

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[31] Specifically, a total of 4 teachers (and several subs) taught the 6th grade class at one point during the 2010-11 school year. The first teacher hired and trained for the Pearson Middle Grade Science program left the school following 1 month. Another teacher was hired and left after 1 month. A third teacher took over the 6th grade science classes and remained for approximately 4 months. This teacher also departed and the school hired a fourth teacher who remained as the science teacher for the remainder of the school year. Given the amount of turnovers, and lack of consistency in science instruction and usage of the Pearson Interactive Science program (as well as possible contamination), the 6th grade classes are excluded from analyses.

incorporating the digital path and not regularly doing labs due to limited resources and student behavioral issues. In particular, the science classrooms were very small and not equipped with traditional lab stations (no heat or water source). Furthermore, while the teacher was provided with a Lab Kit as part of the Pearson program, it was difficult to access other science lab resources (e.g., beakers, scales). Therefore, labs consisted primarily of teacher demonstrations or labs that did not require a lot of resources (e.g., paper/pencil), and at least one occurred for every chapter.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teacher only taught science). Classes lasted for 50 minute periods and occurred every day during the same time for the duration of the year. All students had sufficient copies of student science textbooks.

Science instruction in the control classrooms was generally stable. The teacher would usually spend the first 5 minutes doing a warm-up, which oftentimes included material from the previous day's lesson. For the next 20 minutes the teacher would teach the lesson by reading the science text or having students take turns reading. During the reading, the teacher would stop and ask questions related to the material they had read, elaborating on concepts as needed. Students also were directed to write notes. The main lesson was followed by independent practice which sometimes included pairs/small group work.

Lessons in the treatment classrooms were similar in structure to the control class. Lessons started with the brief warm up activity while the teacher took roll. Depending on where they were within a module, they would begin with the Getting Started (if beginning a new chapter), or the lesson itself. The lesson text was read aloud by the students (round robin). As directed within the TE, the teacher would stop to ask questions and encourage discussion. The teacher also made sure students completed Write-In Student Edition activities as they appeared in the student edition (e.g., Assess Your Understanding, Do the Math, etc.). These were typically completed independently, with the teacher checking student work. Other in-class independent practice typically consisted of Practice worksheets, lesson quizzes, and Review & Reinforce worksheets. Homework was not assigned.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking homework, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teacher used Pearson program materials such as Lesson Quiz, Chapter Tests, and custom tests from Exam Pro. For control classes, the teacher created her own tests.

Comparability: In terms of overall comparability, both the Pearson Interactive Science and the control classrooms were similar. For example, science vocabulary and science facts/concepts were presented in both treatment and control classes and students in both treatment and control were taught the similar concepts, although the sequence and materials used were different. There were some disparities in the amount of independent in class practice that students engaged in, specifically treatment students had more practice opportunities given the interactivities presented in the Pearson program than did their control counterparts. As well, control students wrote notes

in a science journal, while treatment students kept their notes within the Write-In Student Edition. Among the participating teacher's classes, no contamination was noted and student engagement and interest was average.

School F (NY)

About the School: School F is a public school located in an upper middle class, suburban community in New York. It was noted that parent involvement was an integral part of the general school climate and that there were often parent volunteers visible in different roles around the school   The school consists of a well-kept building that is neither especially old nor new. The school houses students in grades 6-8. During the 2009-2010 school year, enrollment at School F was 1080, with a student to teacher ratio of 24 to 1.

In 2009, New York used the New York State Assessments to test students in grades 5 and 8 in science. The tests are standards-based, which means they measure how well students are mastering specific skills defined for each grade by the state of New York. Results show that 86% of 8th grade students at School F were proficient in science, which is higher than the state average of 71%. The student population is predominantly White:

- 69% White
- 4% Hispanic
- 16% Black
- 11% Asian/Pacific Islander
- <1% American Indian/Alaskan Native

Approximately 8% of the students at the school were eligible for free or reduced-price lunches, and 1% were classified as Limited English Proficient.

Study Participants: Seven teachers participated in the study: three treatment teachers and four control. At the 6th grade level, two teachers were assigned to the control condition and each had two class periods (4 control classes total); one teacher was assigned to the treatment condition and also taught two class periods. At the 7th grade level, both the treatment and control teacher taught two class periods for a total of four classes (2 control and 2 treatment). At the 8th grade level, the treatment teacher taught two class periods and the control teacher taught one class period. Thus, there were 13 participating study classes. The 13 classes contained approximately 314 students, with an average class size of 25, and a range of 13-29.

For the most part teachers characterized their classes as average, with some high performing and low performing students, with a couple exceptions. One 6th grade control teacher indicated that her students tended to be high performing. As well, the 8th grade control and 7th grade treatment teachers reported that they had more lower performing students as compared to other 8th and 7th grade classes. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: Control teachers had available to them a 2001 copyright basal science program (same used at School E). However, control teachers generally used this program only as supplemental reading and for note-taking purposes. Instead, teachers relied heavily on teacher-created lessons, including worksheets, lab books, and Powerpoints, as well as resources found on the internet (e.g., Discovery Education, United Streaming, Google images, etc.) or other published materials. Thus, control teachers did not use any specific program but rather followed the district's science curriculum pacing guide and drew upon existing materials from a variety of sources to teach towards the New York state science standards. In addition, grade-specific teacher teams created materials, for example Powerpoints for lessons, lab books, unit review and final exams, which were used by control teachers.

Given that a variety of materials were used to teach science among control teachers, there were very few similarities between the "control program" and the Pearson Interactive Science program. Similarities included lab opportunities and focus on science vocabulary. In addition, both treatment and control teachers used technology regularly to teach and demonstrate science concepts. However, other than teaching similar content, as all teachers followed a district curriculum map, the control and treatment program varied substantially. Notably, treatment teachers were provided with a new, structured science program based on "Understanding by Design" and each student had their own Write-In Student Edition, whereas control teachers used a mix of materials that they had collected over the years and put together into a custom science program aligned to their district pacing guide.

As noted, a district pacing guide was in place and all teachers indicated they followed these closely. In treatment classes, the teachers were observed following the Pearson Interactive Science program and adhering to the implementation guidelines, with the exception of labs. In general, one lab (Quick, Inquiry Warm-Up, or Lab Investigation) was completed for each chapter as opposed to each lesson. Teachers commented that there was simply insufficient time to attempt to do a lab per lesson, as it would normally take an entire class period. In addition, treatment teachers also commented that they supplemented on occasion to address other instructional needs (e.g., prepare students for state testing) or to offer activities that have "worked well" for students in the past (e.g., labs or science videos). That said, this did not occur on a regular basis.

Instructional Practices and Strategies: Science instruction occurred throughout the day depending on the teacher. Classes lasted for 40-minute blocks and occurred every day during the same time.

Science instruction in control classrooms was generally similar with some differences as noted below. Overall teachers would begin instruction with bell work (Do Now). This was done either independently or in pairs. Teachers then reviewed the bell work and homework prior to commencing the lesson. The lesson was generally done whole group. One teacher used Powerpoints to deliver lessons to facilitate note-taking. Some lessons also consisted of videos demonstrating a science concept or online demonstrations. During lessons, teacher-led discussions occurred to elaborate on concepts. At the close of the main lesson, control teachers would provide independent practice (e.g., worksheets) so that students could apply what they had learned. Although this was generally done independently, most teachers would allow students to

help one another. At the conclusion of the lesson, teachers did a wrap-up that consisted of a review of the day's lesson and what they would be doing the following day. Labs were also completed and typically lasted the entire class period. The frequency in which labs occurred varied somewhat, with one 6th teacher completing 1-2 per week and the other completing one every two weeks, the 8th grade teacher completing once per week, and the 7th grade teacher completing at least one per month (though this varied by the unit being covered). Labs were drawn from the school-created lab book, online resources, or other available resources and were generally teacher-directed.

In the treatment classrooms lessons were very similar, in part because most participating teachers followed the implementation guidelines and prescribed pacing and therefore the structure of the treatment lessons were extremely similar. The structure of the lessons were dependent on where teachers were at in the Pearson Interactive Science module, or if they were doing a lab. A typical lesson day started with teachers assigning bell work (Do Now). The activity varied but typically involved doing an activity within their student Write-In Student Edition (e.g., reading My Planet Diary, completing an interactive activity, etc.). Teachers then reviewed the bell work, oftentimes turning it into a discussion about the day's goals. Next teachers would complete the lesson, sometimes incorporating technology. For example, one teacher used the etext to show My Planet Diary on the SmartBoard whereas another teacher used the Digital Path's Interactive Art to show a science concept. The use of technology was done to get students engaged and thinking about the concepts they would be learning. Following the TE, teachers would probe students in order to exercise higher-level thinking and reasoning skills, and would encourage students to provide real life examples related to the concept. Teachers would also have students complete Write-In Student Edition activities as they appeared in the student book, though they did not have students complete all of the activities. These work text activities were selected based on student needs. For the most part however, teachers aimed to have students complete the Apply Its and Assess Your Understandings. If there was time left, teachers typically provided a Pearson worksheet (e.g., Review & Reinforce, Lesson Quiz, Enrich), or have them read or complete additional pages of the Write-In Student Edition independently. Generally unfinished work went as homework. On lab days, teachers would generally hand out the accompanying worksheet for the Quick Lab, Inquiry Warm-Up, or Lab Investigation and read the directions to the students. In general, the teacher would guide students as they completed the lab, so that it was teacher-led as opposed to student-led. Of note, is that some labs were done as teacher demonstrations (e.g., when they felt it would take too much time for students to complete in a 40 minute class period). As previously noted, these did not occur as often as indicated in the implementation guidelines due to limited time availability.

Homework was somewhat consistent between treatment and control classes, with the exception that they used different materials. All teachers (both treatment and control) assigned homework four days per week. Among control teachers, homework generally consisted of unfinished work, vocabulary, note-taking, doing online activities, or completing teacher-created materials. Among treatment classes, homework also consisted of activities such as unfinished work, vocabulary, assignments from the Write-In Student Edition or worksheets from the program.

Assessment: In terms of assessment, treatment teachers gave chapter tests and lesson quizzes, though the latter were primarily used to check student understanding and was not necessarily

graded. Among control teachers, topic tests were given every two weeks, and sometimes quizzes were used at grades 7th and 8th. The 6th grade control teachers also gave unit tests which assessed science facts and vocabulary. Informal assessments occurred in all classrooms (e.g., observations, discussions, etc.).

Comparability: In terms of comparability, both the Pearson Interactive Science and the control classrooms, with the exception of the program-based activities, were similar overall. As all teachers had to follow the district pacing guide, teachers covered similar content while using different materials to do so. For example, vocabulary was equally emphasized in both types of classes and both types of classes incorporated thinking and reasoning skill, however treatment teachers accomplished this by using PIS, while control teachers used district and teacher-created resources. Labs were completed with similar frequency (about every two weeks), though one 6th grade and 8th grade control teacher indicated completing them weekly. Both types of classes also incorporated the use of technology to engage students and demonstrate science concepts, however control teachers tended to have students access resources outside of the classroom more often than treatment teachers. In addition, no contamination was noted.

School G (OH)

About the School: School G is a public school located in a middle class, rural community in Ohio. The school consists of a new building that houses students in grades 7-8. This building is also attached to the high school that houses students in 9-12. During the 2010-2011 school year, enrollment at School G was 320, with a student to teacher ratio of 26 to 1.

In 2011, Ohio used the Ohio Achievement Assessments to test students in grades 5 and 8 in science. The tests are standards-based, which means they measure how well students are mastering specific skills defined for each grade by the state of Ohio. Results show that 70% of 8th grade students at School G were proficient or above in science, which is lower than the state average of 77%. The student population is predominantly White:

- 99% White
- <1% Black

Approximately 43% of the students at the school were eligible for free or reduced-price lunches, and 13% were classified as Students with Disabilities.

Study Participants: Two teachers participated in the study: each teacher taught both treatment and control classes. At the 7th grade level, the teacher taught a treatment class period and a control class period for a total of two classes (1 control and 1 treatment). At the 8th grade level, the teacher taught one treatment class period and one control class period for a total of two classes (1 control and 1 treatment). Thus, there were 4 participating study classes. The 4 classes contained approximately 120 students, with an average class size of 30, and a range of 29 to 32.

For the most part teachers characterized their classes as average, with some high performing and low performing students, with one exception. The 8th grade teacher indicated that the control class her students tended to be lower performing. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The control program consisted of a 2009 middle grades science textbook. In general, the teacher used this basal program as the main science curriculum. Teachers noted that the control program was very similar to the Pearson Interactive Science program in content yet presented it in different ways. Similarities between the two programs include modular chapter based arrangement that includes opportunities for labs and hands on inquiry. Both programs also emphasize math practice activities and activities that reinforce key concepts. The Pearson Interactive Science program however differs from the control program in its Understanding by Design pedagogy and its emphasis on independent, interactive science practice.

In treatment classes, the teachers were observed following the Pearson Middle Grades Science program exclusively and mostly adhering to the implementation guidelines. It was noted that the teachers opted to exclude some of the lab activities (mostly Lab Investigation activities) or use as a teacher demonstration only for lack of time. Teachers stated however, that they were able to complete most of the required Inquiry Warm Up labs and Quick Labs.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teachers only taught science). Classes lasted for 50 minute periods and occurred every day during the same time for the duration of the year. All students had sufficient copies of student science textbooks.

Science instruction in the control classrooms was similar across study teachers. The teachers would usually spend the first 5 minutes doing a bell ringer activity, which included practice questions from the Ohio Achievement Assessment. The teachers would then poll the students for answers and briefly discuss the correct answer. The teachers would do a quick homework check and for the next 20 minutes, teachers would teach the lesson with a lecture and discussion. Students also are directed to write notes. The main lesson was followed by a teacher demo or guided reading activities and independent practice which typically included a worksheet. Anything that was not finished in class was assigned as homework.

Lessons in the treatment classrooms were similar in structure to the control class. Lessons started with the same bell ringer activity while teachers took roll and checked homework. Depending on where they were within a module, they would begin with the Getting Started (if beginning a new chapter), or the lesson itself. Students worked with their table partners to read the text and complete the Write-In Student Edition activities. The teacher would then review the Write-In Student Edition activities as a class while lecturing briefly about the concepts and asking questions to encourage discussion. The teachers often used the Digital Path activities projected on their MimeoBoards to illustrate concepts during the lecture. This was followed by teacher directed note taking and an independent practice activity which typically consisted of modified worksheets from the PIS program, lesson quizzes, and Review & Reinforce worksheets. Anything not completed in class was assigned as homework. On a day in which a

lab activity was to occur the teacher would begin the activity following the bell ringer activity by reviewing the directions and the previously learned concepts that they would need to complete the activity. Students were then directed to independently complete their lab write ups and/or worksheet.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking homework, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teachers used Pearson program materials such as Chapter Tests, and custom tests from ExamView. For control classes, the teachers created their own tests or used items from the control textbook.

Comparability: In terms of overall comparability, both the Pearson Middle Grades Science and the control classrooms were similar. Teachers placed similar emphasis on science vocabulary and science facts/concepts and students in both treatment and control were taught the same concepts. There were some disparities in the amount of group work that students engaged in, specifically treatment students had more opportunities for small group time as the students were allowed to completed the interactive book work in pairs whereas the control students completed guided reading activities independently. As well, control students had fewer opportunities for hands on lab activities (only 2-3 per month), while treatment students completed a hands on lab activity at least once a week. Among the participating teachers' classes, no contamination was noted and student engagement and interest was average.

School H (OH)

About the School: School H is a public school located in a middle class, rural community in Ohio. The school consists of a very well kept building that houses students in grades K-6. During the 2010-2011 school year, enrollment at School H was 324, with a student to teacher ratio of 22 to 1.

In 2011, Ohio used the Ohio Achievement Assessments to test students in grades 5 and 8 in science. The tests are standards-based, which means they measure how well students are mastering specific skills defined for each grade by the state of Ohio. Results show that 84% of 5th grade students at School H were proficient or above in science, which is higher than the state average of 82%. The student population is predominantly White:

- 99% White
- <1% Black
- <1% Hispanic

Approximately 42% of the students at the school were eligible for free or reduced-price lunches, and 11% were classified as Students with Disabilities.

Study Participants: One 6th grade teacher participated in the study: this teacher taught both a treatment and a control class due to the small school population. This teacher taught one class as a control class and the other as a treatment class. Thus, there were 2 participating study classes. The 2 classes contained approximately 49 students, with an average class size of 25, and a range of 23 to 26.

For the most the teacher characterized the classes as average, with some high performing and low performing students. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The 6th grade control program consisted of a 2000 middle grades science textbook. In general, the teacher used this basal program as the main science curriculum though some modifications were made to adhere to the school's curriculum map. This control program is similar to the Pearson Interactive Science program in its modular chapter based arrangement and emphasis on hands on investigative activities. Both programs also include and emphasis on vocabulary with highlighted terms in the text as well as integrated activities that reinforce key concepts. However, the Pearson Interactive Science program differs from this control program largely in its in-depth coverage of important science concepts and opportunities for independent practice.

In treatment classes, the teacher was observed following the Pearson Interactive Science program exclusively and adhering to the implementation guidelines. The teacher noted that the science classroom was small and not equipped with traditional lab stations (no heat or water source) and was not accustomed to completing many lab activities but was able to complete all the required labs as part of the participation in the study.

Instructional Practices and Strategies: Science instruction occurred before lunch for the treatment students and after lunch for the control students (the study teacher also taught math). Classes lasted for 40 minute periods and occurred every day during the same time for the duration of the year. All students had sufficient copies of student science textbooks.

Science instruction in the control classroom was relatively consistent. The teacher would usually follow the textbook closely and spend most of the class instruction reading the text aloud as a group. During the reading, the teacher would stop and ask questions related to the material they had read, elaborating on concepts as needed. Students also are directed to write notes. The main lesson was followed by independent practice which sometimes included pairs/small group work. Labs only occurred in the control classroom 4-5 times per year and were typically completed in groups. The teacher would poll the small groups at the completion of the lab for their individual findings and reflections of the activity. Homework was assigned 1-2 times per week and typically consisted of end of lesson and chapter review questions in the textbook.

Lessons in the treatment classrooms were similar in structure to the control class. Depending on where they were within a module lessons would begin with reading the Write-In Student Edition. The lesson text was read aloud by the students (round robin). Throughout the reading, the teacher would stop to ask questions and encourage discussion. The teacher also made sure students completed Write-In Student Edition activities as they appeared in their book. These activities

were typically projected onto the SmartBoard and incorporated into the discussion. They were typically completed independently, with the teacher checking student work. Other in-class independent practice typically consisted of lesson quizzes, lab worksheets and the Write-In Student Edition study guide. On days in which a lab activity occurred, the lesson would begin by reading the lab assignment and directions out loud as a class and reviewing any concepts that would be necessary for the completion of the lab. Lab activities were typically completed in small groups assigned by the teacher. After the lab was completed the teacher would poll the groups for their results and conclusions. Homework was assigned 1-2 times per week.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Informal assessment (i.e. observation, checking homework, discussion, etc.) and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teacher used Pearson program materials such as Lesson Quiz, Chapter Tests, and custom tests from ExamView. For control classes, the teacher created his own tests or used questions from the textbook.

Comparability: In terms of overall comparability, both the Pearson Middle Grades Science and the control classrooms were similar in terms of overall structure and content coverage. There were some disparities in the amount of independent in class practice that students engaged in, specifically treatment students had more practice opportunities given the interactivities presented in the Pearson program than did their control counterparts. As well, control students had fewer opportunities for hands on lab activities (only 4-5 a year) whereas students using the Pearson program completed an inquiry activity 2-3 times per week. Among the participating teacher's classes, no contamination was noted.

School I (PA)

About the School: School I is a public school located in an upper middle class, suburban community in Pennsylvania. The school consists of a well-kept building that is neither especially old nor new. The school houses students in grades 5-8. During the 2010-2011 school year, enrollment at School I was 624, with a student to teacher ratio of 15 to 1.

In 2010, Pennsylvania used the Pennsylvania System of School Assessment (PSSA) to test students in grades 4 and 8 in science. The tests are standards-based, which means they determine the degree to which school programs enable students to attain proficiency of Pennsylvania academic standards. Results show that 62% of 8th grade students at School I were proficient in science, which is higher than the state average of 57%. The student population is predominantly White:

- 97% White
- 2% Black
- <1% Hispanic
- <1% American Indian/Alaskan Native

Approximately 39% of the students at the school were eligible for free or reduced-price lunches, and none of their students were classified as Limited English Proficient.

Study Participants: Three teachers participated in the study: each teacher was a treatment teacher and a control depending on the semester. Because a full year of science was taught in one semester each teacher had a different set of students in the first semester and second semesters. At the 6th grade level, one teacher was assigned to the treatment condition first semester with one class period; this teacher was then assigned to the control condition at second semester with one class period. At the 7th grade level, one teacher was assigned to the treatment condition first semester with one class period; this teacher was then assigned to the control condition at second semester with one class period. At the 8th grade level, one teacher was assigned to the control condition first semester with one class period; this teacher was then assigned to the treatment condition in second semester with one class period. Thus, there were 6 participating study classes. The 6 classes contained approximately 151 students, with an average class size of 25, and a range of 23 to 28.

For the most part teachers characterized their classes as average, with some high performing and low performing students. Overall classes were noted as typical of the student population.

Science Curriculum and Resources: The control program consisted of a 2007 middle grades science textbook which was an earlier version of the control program used at School G. In general, the teacher used this basal program as the main science curriculum supplementing with teacher created resources where needed. The structure philosophy and pedagogy of the control program remained constant in this version of the program with teachers also noting that the control program was very similar to the Pearson Interactive Science program in content though the presentation differed. Similarities between the two programs include modular chapter based arrangement that includes opportunities for labs and hands on inquiry. Both programs also emphasize math practice activities and activities that reinforce key concepts. The Pearson Interactive Science program however differs from the control program in its Understanding by Design pedagogy and its emphasis on independent, interactive science practice.

In treatment classes, the teachers were observed following the Pearson Middle Grades Science program exclusively and mostly adhering to the implementation guidelines. It was noted that the 7th grade teacher did not use the Digital Path technology and the Untamed Science Videos as he was uncomfortable using the technology and did not have access to a DVD player in the classroom.

Instructional Practices and Strategies: Science instruction occurred throughout the day (the study teachers only taught science). Classes lasted for 80 minute periods and occurred every day during the same time for the duration of the year. As previously noted, teachers had one set of students during first semester and a new set of students during second semester. It should be noted that the block scheduling of the science classes allowed for a full year's science content to be taught in one semester. All students had sufficient copies of student science textbooks.

Science instruction in the control classes was similar. The teachers would usually spend the first 5 minutes doing a bell ringer activities and agenda check. In the 8th grade, bell ringer activity

typically included practice questions from the PSSA, otherwise the bell ringer included a question from an old test or quiz. The teachers would then begin the lesson with a lecture, discussion and note-taking. The main lesson was followed by a teacher demo or independent practice which typically included a teacher created worksheet or questions from the textbook. This activity could also be completed in groups at the students choosing. Anything that was not finished in class was assigned as homework. On days in which a lab activity occurred, a brief review would follow the bell ringer activity in preparation for the lab. Depending on the type of lab activity (short lab vs. full class) this would take anywhere from 15-40 minutes and would follow with some independent practice and wrap up.

Lessons in the treatment classrooms were similar in structure to the control class. Lessons started with the same bell ringer activity while teacher took roll and checked homework. If this was the beginning of a lesson, the teachers would complete the Inquiry Warm Up lab either as a hands on or teacher demonstration before beginning the lecture. The teachers would lead the class in reading the text and completing the Write-In Student Edition activities as they appeared in the student edition while lecturing. The 6th and 8th grade teachers supplemented the lecture by using the digital path activities and PowerPoints included in the PIS digital path. Because of the block scheduling teachers often had time to include the Quick Lab activity following the lecture. It was noted that this was sometimes done as a teacher demonstration to expedite the lab. This was followed by an independent practice activity which typically consisted of modified worksheets from the PIS program, lesson quizzes, and Review & Reinforce worksheets. Anything not completed in class was assigned as homework.

Assessment: In terms of assessment practice there was very little variation between the control and treatment classes. Teachers at school I had to follow a district assessment policy so assessment opportunities remained consistent. Informal assessment (i.e. observation, checking homework, discussion, etc.) lesson quizzes and chapter tests occurred with equal regularity and in similar ways in all classes; the main difference between the treatment and control classes was in the materials used for assessment. For treatment students, the teachers used Pearson program materials such as lesson quizzes, Chapter Tests, and custom tests from ExamView. For control classes, the teachers created their own tests or used items from the control textbook. It was also noted that for both treatment and control classes the lab write ups, specifically the analyze and conclude sections, were used to assess student learning.

Comparability: In terms of overall comparability, both the Pearson Middle Grades Science and the control classrooms were similar. As previously stated teachers were required to follow consistent assessment and grading activities as well as a district curriculum map so content coverage was comparable.   Although the Interactive Science program had more opportunities for hands on inquiry and independent practice, this was also equally emphasized in both treatment and control classrooms. Among the participating teachers' classes, no contamination was noted and student engagement and interest was average.

Appendix D:

Key Features and Resources for Treatment and Control Programs

Table D1. Program Features and Pedagogy of Treatment and Control Programs

	Pearson Interactive Science	Control Program 1: (2004)	Control Program 2: (2001)	Control Program 3: (2001, 2007, 2009)	Control Program 4: (2000)	Control Program 5: (2005)

Key Program Features and Pedagogy	▪ Understanding by Design (UbD) framework
	▪ "Big Ideas" serve as the overarching concept for each lesson.
	▪ Utilizes the 5 "E"s (engage, explore, explain, elaborate, evaluate) to unlock the "Big Q" in every lesson/chapter
	▪ Lab Activities integrated into each lesson
	▪ 21st Century skill connections are emphasized
	▪ Organized into 12 modules covering Life, Earth, Physical and Science and Technology
	▪ Modules contain 4-8 chapters broken down into anywhere from 3 to 6 lessons.
	▪ Lessons typically consist of the following elements:
	  ○ Prior knowledge is tapped and prerequisite skills are identified with Check your Understanding and My Planet Diary.
	  ○ Introduction to the lesson with an Inquiry Warm Up lab
	  ○ Figures/Activity Art for active visual connections
	  ○ Quick labs and Lab Investigations for hands on inquiry experiences
	  ○ Vocabulary development
	  ○ Integrated Do the Math Activities to connect math skills to newly learned science topics
	  ○ Built in assessment prior to independent practice in the form of Got Its
		▪ Hands on science program with lessons organized around lab investigations
		▪ Lessons encourage students to make connections between evidence and explanations.
		▪ Multimedia activities are woven into instruction
		▪ Lessons typically consist of the following elements:
		1) Introduction and lesson of new topics
		2) Lesson investigation to engage students and garner interest in the lesson topic
		3) Built in assessment.
		▪ Provides an emphasis on hands on scientific inquiry and investigation activities.
			▪ Lessons designed around a connection to other areas of science.
			▪ Built in assessments and lab activities
			▪ Feature articles following every chapter emphasizing Science and technology in the real world.
			▪ Lessons typically consist of the following elements:
			  ○ Introduction to lesson key topics and terms to learn.
			  ○ Math break activity
			  ○ Science Connection
			  ○ Lab activity
			  ○ Built in Review questions
				▪ Lessons organized around hands on science inquiry.
				▪ Engaging graphics that reinforce concepts
				▪ Lessons open with engaging investigative projects
				▪ Integrated math skill activities
				▪ Skill and Key concept activities
				▪ Lessons typically consist of the following elements:
				  ○ Introduction to key lesson topics
				  ○ Engaging introductory activities
				  ○ Reading guide
				  ○ Lab activities
				  ○ Highlighted vocabulary terms
				  ○ Connections to other academic subjects
				  ○ Learning checks
				  ○ Built in review
					▪ Lessons deigned around class investigative activities
					▪ Objectives clearly identified at the start of every lesson.
					▪ Lesson utilize facts and questions to spark interest at the beginning of a topic and access prior knowledge
					▪ Lessons emphasize a connection to other academic subjects and cultural connections.
					▪ Lessons typically consist of the following elements:
					  ○ Class Investigative activity
					  ○ Science vocabulary
					  ○ Visual learning activities
					  ○ Wrap up summary and self-assessment
						▪ Chapters include cross-curricular readings and lab activities
						▪ Chapters include opportunities for review and assessment
						▪ Lessons designed around critical thinking opportunities and real world applications.
						▪ Lessons typically consist of the following elements:
						  ○ Introduction to lesson key topics and new vocabulary
						  ○ Reading check.
						  ○ Lab activity
						  ○ Math break activity
						  ○ Science Connection
						  ○ Section Review questions that include math activities

Table D2. Program Resources of Treatment and Control Programs

	Pearson Interactive Science	Control Program 1: (2004)	Control Program 2: (2001)	Control Program 3: (2001, 2007, 2009)	Control Program 4: (2000)	Control Program 5: (2005)

Program Resources	**Student Resources**
	▪ Write in Student Edition
	
	Teacher Resources
	▪ Teacher's Edition
	▪ Teacher's Lab Resource
	▪ Program Guide
	▪ Scenario Based Investigations
	▪ DK Big Ideas Books
	   ▪ DK Visual Glossary
	   ▪ DK Volumes 1-6
	▪ Multilingual Glossary
	▪ Big Ideas Activities and Projects
	▪ Interdisciplinary Activities
	▪ Math Skill and Problem-Solving Handbook
	▪ ELL Handbook
	▪ Reading Strategies Handbook
	▪ Inquiry Skill Handbook I
	▪ Inquiry Skill Handbook II
	▪ Inquiry Skill Handbook III
	▪ Untamed Science videos DVD
		▪ Teacher's Guide
		▪ Student Resources Book
		▪ Transparencies
		▪ Multimedia CD-ROM
		▪ Student Lab Equipment Kit
		▪ Lab Notebook
			▪ Teachers Editions
			▪ Student Edition
			▪ Lab Book
				▪ Student Edition
				▪ Teacher's Edition
				▪ Student Express with Interactive Textbook
				▪ All in one Teaching Resources Including:
				▪ Teaching support
				▪ Labs and activities
				▪ Reading and review
				▪ Assessment
				▪ Color Transparencies
				▪ Guided Reading and Study Workbook
				▪ Student Edition on Audio CD
				▪ Discovery Channel School Video
				▪ Lab Activity Video
				▪ Integrated Science Laboratory Manual
				▪ Computer microscope lab manual
				▪ Inquiry Skills Activity Books
				▪ Progress Monitoring Assessments
					▪ Teachers Editions
					▪ Student Edition
					▪ Lab Book
						▪ Teacher Editions
						▪ Student Edition
						▪ Integrated Lab Activities
						▪ One-Stop Internet Resource Including:
						▪ Online Study Tools
						▪ Online Research
						▪ Interactive online Student Edition
						▪ Resources for Teachers

Table D2. Program Resources continued.

	Pearson Interactive Science	Control Program 1: (2004)	Control Program 2: (2001)	Control Program 3: (2001, 2007, 2009)	Control Program 4: (2000)	Control Program 5: (2005)
	▪ Exam*View*® Test Generator CD-ROM ▪ Professional Development at mypearsontraining.com **Digital Resources** ▪ Student & Teacher Edition ▪ Program Resources & Editable worksheets ▪ Assessment Resources ▪ Lab Zone Activities ▪ Teacher PowerPoints ▪ Lesson by Lesson Blackline masters ▪ Interactive Digital Path ▪ My Science Coach ▪ Vocabulary Flash Cards ▪ Virtual Lab Activities ▪ Dynamic Activities ▪ My Reading Web ▪ Multilingual Support Practice Tests			▪ Test Preparation Woorkbook ▪ Test Taking Tips with Transparencies ▪ Teacher's ELL Handbook ▪ Reading Strategies for Science Content ▪ Teacher Express CD-ROM ▪ Interactive Textbooks online ▪ Presentation Express CD-ROM ▪ ExamView Test Generator CD-ROM ▪ Lab zone – Easy Planner CD-ROM ▪ Probeware Lab Manual with CD-ROM ▪ Computer Microscope and Lab Manual ▪ Discovery Channel School DVD Library ▪ Lab Activity DVD Library		

*Note that while these are the program materials listed with the control program, it us unknown whether control teachers had access to all of these resources whether because they were not purchased initially or because items have been transferred from teacher to teacher and lost over time, etc. In general, however, control teachers had access to the Student Editions, Teacher Edition, and lab book. In addition, control teachers may have incorporated other program materials (other than the primary program).

Table D3. Science Topics in Treatment and Control Programs

	Pearson Interactive Science	Control Program 1: (2004)	Control Program 2: (2001)	Control Program 3: (2001, 2007, 2009)	Control Program 4: (2000)	Control Program 5: (2005)
Science Topics Covered	**Module 1 - Science & Technology** (includes Nature of Science, Scientific Inquiry, Scientific literacy, the tools of science, and technology and engineering)		**Limited Coverage**	X		
	Module 2 – Earth's Structure (includes the Earth System, minerals and rocks, plate tectonics, earthquakes, and volcanoes)		X	X	X	X
	Module 3 – Earth's Surface (includes mapping the Earth's surface, topographic maps, weathering and soil, erosion and deposition, fossils, and earth's history)	X	X	X	X	X
	Module 4 – Water & Atmosphere (includes water, oceans, the atmosphere, weather and climate)	X	X	X	X (does not include fresh water and climate change)	X
	Module 5 – Astronomy and Space Science (includes earth, moon and sun, space, the solar system, stars, galaxies and the universe)	X	X	X	X	X
	Module 6 – Ecology & the Environment (includes populations and communities, ecosystems and biomes, resources and living things, land air and water resources and energy resources)	X	X	X	X (does not include populations and communities, land air and water resources and energy resources)	X
	Module 7 – Cells & Heredity (includes cells, cell processes and energy, genetics and heredity, DNA, genetic technology, and evolution)		X	X	X (limited coverage of cells, genetics and heredity only)	X
	Module 8 – Diversity of Life (includes classifying life, viruses, bacteria, protists, fungi, plants, animals, animal systems, animal digestion, circulation and excretion, and animal reproduction and behavior)	X	X	X	X (does not include viruses, bacteria, protists, fungi, animal reproduction and behavior)	X

Table D3. Science Topics continued

	Pearson Interactive Science	Control Program 1: (2004)	Control Program 2: (2001)	Control Program 3: (2001, 2007, 2009)	Control Program 4: (2000)	Control Program 5: (2005)
	Module 9 – Human Body Systems (includes the human body, bones, muscles and skin, digestion, circulation, respiration and excretion, diseases, the nervous system, endocrine system and reproduction)	X (only includes the human brain)	X	X		X
	Module 10 – Intro to Chemistry (includes the classifying matter, solids, liquids and gases, atoms, periodic table, metals, ionic and covalent bonds, chemical reactions, acids bases and solutions)	X	X	X	X (does not include ionic and covalent bonds, acids bases and solutions)	X (does not include acids bases and solutions)
	Module 11 – Forces & Energy (includes motion, forces, work and machines, energy, thermal energy and heat, electricity and magnetism and electromagnetism)	X	X	X	X (only covers energy and magnetism)	X
	Module 12 – Sound & Light (includes characteristics of waves, sound, electromagnetic waves, and light)		X	X	X (limited coverage)	X

*Note that the above crosswalk reflects what content is available from each respective control program. Actual content taught is discussed in the main report, on pages 30-31.

Appendix E:

Use of Pearson Interactive Science Resources

Table E1. Percent of Usage of Key Pearson Interactive Science Program Components

	Never-Rarely	Sometimes (1-2 times per chapter)	Often (1-2 times per week)	Very Often (Everyday or almost everyday)	Often-Very Often
Review the vocabulary section of the Write-In Student Edition	0%	8.7%	17.4%	73.9%	91.3%
Have students complete the Check Your Understanding sections of the chapter	0%	8.7%	26.1%	65.2%	91.3%
Assign the Apply It! activity sections in the Write-In Student Edition	0%	8.7%	47.8%	43.5%	91.3%
Assign the "Explore the Big Question" activity sections in the Write-In Student Edition	0%	13%	65.2%	21.7%	86.9%
Review answers to Assess Your Understanding sections of the Write-In Student Edition	4.3%	13.0%	30.4%	52.2%	82.6%
Assign the "Do the Math" activity sections in the Write-In Student Edition	0%	26.1%	38.8%	39.1%	77.9%
Reference the Big Question throughout the chapter	0%	26.1%	21.7%	52.2%	73.9%
Use Figures/Activity Art/Animations in Write-In Student Edition to reinforce instruction	4.3%	21.7%	34.8%	39.1%	73.9%
Introduce the Big Question at the beginning of a new topic	0%	26.1%	43.5%	30.4%	73.9%
Introduce a new topic or lesson by using a Lab Zone embedded in the Write-In Student Edition	0%	26.1%	56.5%	17.4%	73.9%
Begin each lesson with My Planet Diary	0%	26.1%	17.4%	56.4%	73.8%
Plan your lessons according to Understanding by Design (Engage, Explore, Explain, Elaborate, Evaluate)	8.7%	21.7%	30.4%	39.1%	69.5%
Use embedded Lab Zones in the Write-In Student Edition to reinforce your instruction or lecture	13%	21.7%	47.8%	14.4%	62.2%
Had students watch Untamed Science Videos	4.3%	39.1%	26.1%	30.4%	56.5%
Answered questions following the Untamed Science Videos	13%	43.5%	8.7%	34.8%	43.5%

*% reflects reported percent of Spring Surveys where teachers reported using the listed program components as noted.

Table E2. Percent of Usage of Additional Pearson Interactive Science Program Components

	Never-Rarely	Sometimes (1-2 times per chapter)	Often (1-2 times per week)	Very Often (Everyday or almost everyday)	Often-Very Often
Use the lesson quizzes	8.7%	8.7%	47.8%	34.8%	82.6%
Use the Key Concept summaries	4.3%	34.8%	34.8%	26.1%	60.9%
Use the differentiated-activities worksheets (Review & Reinforce and Enrich)	39.1%	8.7%	26.1%	26.1%	52.2%
Use the study guide	4.3%	47.8%	21.7%	26.1%	47.8%
Use the After the Inquiry Warm-Up worksheets	34.8%	21.7%	26.1%	17.4%	43.5%
Use the Differentiated Instruction activities noted in your TE	47.8%	26.1%	13%	13%	26.0%
Use the 21st Century Skills sections of your TE to reinforce these skills	56.5%	26.1%	4.3%	13%	17.3%

*% reflects reported percent of Spring Surveys where teachers reported using the listed program components as noted.

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