

Improving the science content, inquiry, and literacy skills of second-grade students:

# **A study of the effectiveness of *National Geographic Science***

**2009–2010**



**Cultivating learning and positive change**

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# Improving the science content, inquiry, and literacy skills of second-grade students: A study of the effectiveness of *National Geographic Science*

## Background and Purpose

National Geographic School Publishing (NGSP) recognizes the importance of gathering scientific research evidence to support educators in making decisions about instructional programs. As such, NGSP contracted with Magnolia Consulting, LLC, an independent evaluation consulting firm, to conduct an efficacy study of *National Geographic Science* (*NG Science*), a comprehensive core science program for students in kindergarten through grade five, during the 2009–2010 school year.

*NG Science* is a research-based program that unlocks the Big Ideas in science for all learners, immerses students in the nature of science and science inquiry, and builds scientific and content literacy. *NG Science* brings science learning to life through the lens of National Geographic while meeting established science standards for life, earth, and physical science. *NG Science* uses connections to real scientists and explorers along with hands-on, inquiry activities that encourage students to “think like scientists” as they learn standards-based science content. Students experience four levels of inquiry investigation (explore, directed, guided, and open) and use a science notebook to deepen their scientific understanding. In *NG Science*, carefully leveled and engaging informational text and visuals work in tandem with the scaffolded inquiry experiences to build all students’ scientific literacy.

The purpose of this study was to measure the efficacy of *NG Science* in improving students’ science content knowledge, understanding of scientific inquiry skills and the nature of science, reading abilities, and interest in science. This study also included an examination of teachers’ implementation of *NG Science* as well as their perceptions about science instruction and student motivation and learning.

Overall, use of *NG Science* with second-grade students during one school year’s time was found to enhance science learning and support science instruction. *NG Science* students demonstrated a more informed understanding of scientific inquiry and the nature of science than control students. Results of this study clearly demonstrate that *NG Science* supports students’ mastery of science content, inquiry skills, and scientific and content literacy skills.

## Study Design

During the 2009–2010 school year, Magnolia Consulting conducted a study with 42 teachers and 858 second-grade students nationwide. Evaluators employed a randomized, controlled trial design (RCT) with students nested in classrooms in order to measure program impacts on students’ science content knowledge, inquiry skills, reading ability, and interest in science. Classes were randomly assigned to either the *NG Science* or control groups.

Student measures for both study groups included: science content assessment, inquiry assessment, science notebook review, reading assessment, and student interest survey. Evaluators analyzed the data to detect differences between the two study groups and also among student subgroups participating in this study. Evaluators also analyzed data collected from both *NG Science* and control group teachers including ongoing implementation logs and classroom observations and interviews in the spring of 2010.

## Results

### Science Content Knowledge

**“The Big Idea questions really help my students make overarching connections and categorizations. This bigger piece in science is not something we’ve touched on in the past.”** [*NG Science* teacher, evaluator interview]

An important measure of program effectiveness is the extent to which students master standards-based content objectives. *NG Science* builds a deep understanding of core science content through multiple experiences with science Big Ideas during each unit of instruction. For this study, both treatment (*NG Science*) and control group students were given a standards-aligned content knowledge post-assessment on specific content covered during science instruction in their classroom.

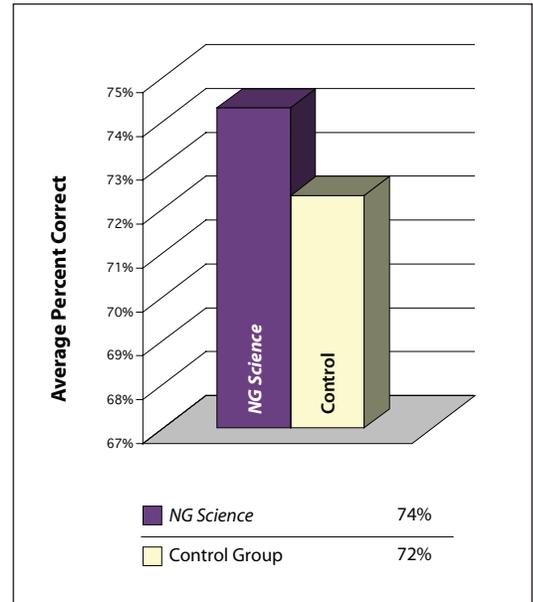
Results of the science content assessment indicate that *NG Science* students scored higher ( $M = 74\%$  correct), on average, than control students ( $M = 72\%$  correct) (see Figure 1). The magnitude of the difference between treatment and control group student scores reflects a small effect size ( $d = .12$ ) that translates to the average *NG Science* student scoring five percentile points higher on the content assessment than the average control student. Though this difference was not statistically significant, these results indicate that *NG Science* supports students’ progress toward mastery of grade-level science concepts and content.

### Nature of Science and Science Inquiry

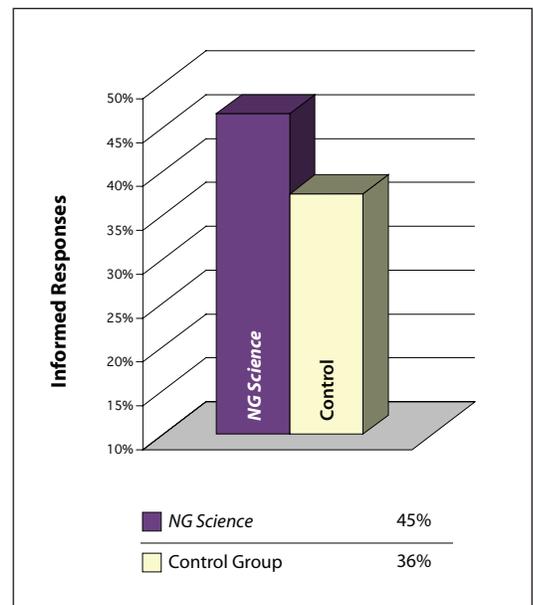
**“My students have a better understanding about asking questions regarding scientific phenomena; making predictions; getting the idea of a fair test; and the importance of record, observe, and then record observations again.”** [*NG Science* teacher, evaluator interview]

Students in the elementary grades need many opportunities that encourage them to think and act as scientists in order to develop an accurate understanding of science, so *NG Science* engages students in a range of authentic inquiry investigations that promote scientific literacy. For this study, The Young Children’s Views of Science Questionnaire (YCVS) was used to measure the impact of *NG Science* focusing on two aspects of Scientific Inquiry: “all investigations begin with a question” and “data and prior knowledge are used to answer questions,” as well as two aspects of Nature of Science: “observations versus inferences” and “empirical basis of science.”

*NG Science* students demonstrated a greater overall understanding of the Nature of Science and Scientific Inquiry than control students who did not use *NG Science*. Overall results indicate that 45% of treatment students’ responses were ‘Informed’ across all areas compared to 36% of control students (see Figure 2), which is statistically significant,  $t(96) = -2.85, p = .005$ .



**FIGURE 1. *NG Science* and control students’ average percent correct on science content assessment**

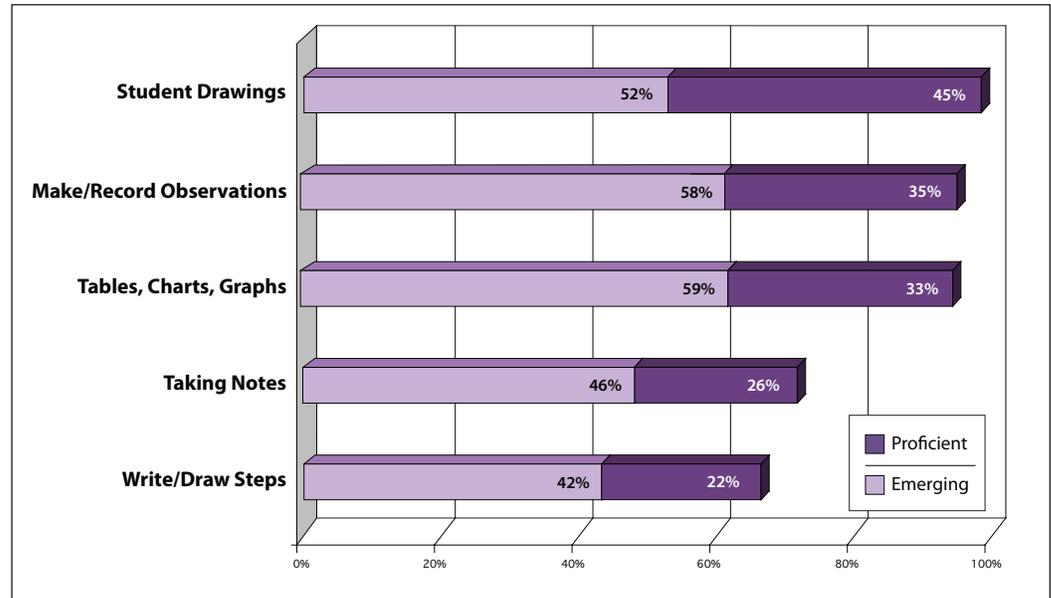


**FIGURE 2. Percentage of *NG Science* and control students’ overall ‘Informed’ responses relative to Nature of Science and Scientific Inquiry**

## Science Notebooks

**“My students feel more like scientists. They realize there is a difference in writing scientifically now. The notebooks provide a place they value and are excited about to collect their information.” [NG Science teacher, evaluator interview]**

Science notebooks are an integral element of *NG Science*, providing students a place to organize their thinking and document their scientific experiences. To examine the impact of this tool, *NG Science* students’ science notebooks were reviewed using a rubric that assessed the nature and frequency of use, student proficiency, and the extent to which the notebook supported instruction.



**FIGURE 3. Percentage of *NG Science* students’ science notebook ratings at ‘emerging’ or ‘proficient’ for observational data**

Results indicate that

science notebooks can be a purposeful tool to enhance students’ understanding of science content and inquiry, as well as for differentiating instruction with *NG Science*. Science notebooks were used most frequently for vocabulary development, note-taking related to science Big Ideas, and in support of inquiry activities. Students’ observational data included charts, tables, graphs, as well as student-recorded notes and observations. Using a three-level scale (not present, emerging, or proficient), the majority of students were at either an emerging or proficient level for all aspects of recording observational data (see Figure 3). Students showed the greatest proficiency in detailed drawings that supported their observations, were accurately labeled, and tied to the Big Ideas of lessons. These findings support the use of science notebooks as part of *NG Science* to help students develop their scientific process skills and make connections that deepen their understanding of science content and inquiry investigations.

## Reading

**“The reading adds a whole other dimension because students can visually see the photos and go back and reread for information. Before this year, science instruction was hands-on only, and you hoped they grasped the concepts. *NG Science* includes more science concepts that are also reinforced with the reading materials.” [NG Science teacher, evaluator interview]**

The informational text features and strategies in *NG Science* help students develop their literacy skills while they are learning science content and inquiry skills. For this study, reading skills were measured using the Gates-MacGinitie Reading Test, Fourth Edition (GMRT-4).

*NG Science* students demonstrated significant gains in reading on the GMRT-4, including an average gain of 25 percentile points on the Word Knowledge subtest ( $d = .69$ ), 19 percentile points on the Comprehension subtest ( $d = .50$ ), and 31 percentile points on the Total reading score ( $d = .89$ ). *NG Science* students performed higher than control group students on Word Knowledge, Comprehension, and the Total test measure; however these differences were not statistically

significant. These results are understandable given that reading instruction is an area of emphasis for second-grade students.

Students with an Individualized Education Plan (IEP) in *NG Science* classrooms made greater gains in reading comprehension than IEP students in control group classrooms (see Figure 4). This difference may be attributed to the accessibility of the program's leveled readers as well as its focus on differentiated and multilevel instructional strategies. These results suggest that *NG Science* might be especially beneficial for increasing skills among students receiving special services and might help close the achievement gap in reading comprehension.

### Student Interest in Science

**“I’ve never seen the excitement for science like I do with my students this year. The topics, materials, and hands-on activities in *NG Science* draw upon kids’ interests and help them learn.” [NG Science teacher, evaluator interview]**

Effective science instruction capitalizes upon elementary students’ natural curiosity and interest in science in ways that motivate them to continue learning the science that will help them in class and in life. *NG Science* uses real, relevant, and rigorous activities and materials to motivate students to learn science. To examine their interest level in science as a subject area, all students completed a brief survey at the beginning and end of the study.

Given the high level of interest in science all students reported on the baseline survey, the study was unable to detect any significant changes in interest for either study group. Students started the study with a high level of interest in science and generally maintained it throughout the school year. These results reflect the high interest in science content and activities typically exhibited by elementary students.

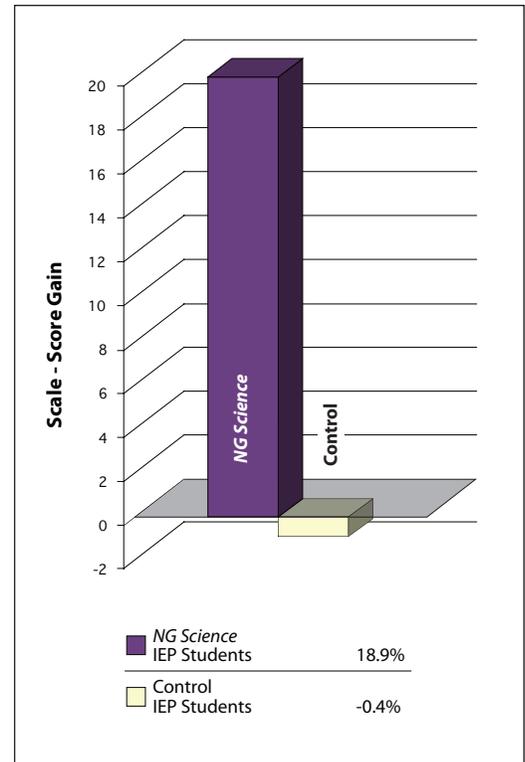
Overall, 93% of treatment group teachers’ reported that *NG Science* had a very positive impact (much/great deal) on their students’ interest in science. *NG Science* teachers also reported that the majority of students (70%) consistently evidenced ‘high engagement’ with the program’s materials and activities.

### NG Science Implementation

**“NG Science makes me more confident in teaching science because there are so many materials to use and they are easy to use. All of the information is there. I can present the Science Misconceptions and the Raise Your SciQ information to students, and I don’t have to question my understanding about every science fact.” [NG Science teacher, evaluator interview]**

Student learning is often directly affected by a teacher’s fidelity of implementation with an instructional program. For this study, implementation information was collected through online teacher logs for both *NG Science* and control group teachers. Additionally, evaluators conducted observations and interviews with a selection of study teachers.

*NG Science* teachers implemented the program with a high level of fidelity (ranging from 65% to >100%) based on identified benchmark criteria. The majority (over 80%) of *NG Science* teachers reported a consistent use of program components and indicated the program was easy to implement in their classrooms.



**FIGURE 4. *NG Science* and control group reading comprehension (GMRT-4) performance with IEP status comparison**

Differences emerged in treatment versus control teacher perceptions of student learning and adequacy of materials in meeting varied students' needs. Higher percentages of *NG Science* teachers than control teachers indicated their students learned much/great deal relative to lesson objectives, academic vocabulary, science content, nature of science, inquiry, and "thinking like a scientist." Additionally, more *NG Science* than control teachers reported that their science materials/program met the full range of differentiated instructional needs of their students (on-level, advanced, below-level, ELL, and IEP students).

*NG Science* teachers were provided an initial two-hour program orientation and were offered follow-up webinar opportunities on topics including: science Big Ideas and vocabulary, science notebooks, nature of science/science inquiry, technology, and informational text. Study results indicate that participation in the science notebooks webinar improved *NG Science* teachers' instructional use of the notebooks. Notebooks of students whose teachers attended the webinar showed significantly higher use and proficiency in note taking,  $t(67) = 4.13, p = .000$ , drawing or writing steps,  $t(67) = 3.50, p = .001$ , and generating new questions,  $t(67) = 3.30, p = .002$ .

## Summary

*NG Science* is a comprehensive core science program that meets the needs of diverse learners within a classroom while covering core science content and standards. *NG Science* offers teachers lessons and materials that support all students in accessing the Big Ideas of science through visually engaging media, scaffolded inquiry activities, and informational texts.

This study measured the efficacy of *NG Science* in improving students' science content knowledge, inquiry skills, and reading ability. This study also examined teachers' implementation of *NG Science* and their perceptions of its impact on student learning and interest in science.

Results of this study clearly demonstrate that *NG Science* supports students' mastery of science content, inquiry skills, and scientific and content literacy skills. Study results show that *NG Science* students demonstrated a more informed understanding of scientific inquiry and the nature of science than control students. *NG Science* also worked better than comparison programs in developing reading comprehension, especially for IEP students included in mainstream classrooms.

By positively impacting students' science content, inquiry, and literacy skills, *NG Science* gives students the foundation to better understand the world around them. These findings demonstrate that *NG Science* is effective in building students' abilities to understand and engage in the scientific process in an authentic and meaningful way.

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