

HMH Science Dimensions™

Middle Grades, An Efficacy Study

Houghton Mifflin Harcourt

Report Number 545

July 2018

Table of Contents

Abstract	1
Overview of the Study	2
<i>Research Questions</i>	2
<i>Design of the Study</i>	2
<i>Program Overview</i>	2
<i>Description of the Assessments</i>	4
<i>Description of the Study Sample</i>	4
Data Analyses and Results	6
Conclusions	8
<i>Research Question 1</i>	8
<i>Research Question 2</i>	8

Abstract

The focus of this study was the effectiveness of the *HMH Science Dimensions Program*™ © 2018–2019. Science Dimensions is a new K-12 program for kindergarten to grade 12 students, published by Houghton Mifflin Harcourt. This study focused on the Grade 6-8 program which includes a total of 12 modules across the three grades. Module C was chosen as the study module. The study included two teachers from two different schools and two different states who agreed to tryout three units of the Middle Grades level of the program. The 139 students were enrolled in either grade 7 or grade 8.

The module chosen for the study Module C: Ecology & the Environment. The length of the study was based on the time it would take each teacher to complete the instruction for the units. Teachers took approximately twelve weeks to complete the study beginning January 2018 and ending the beginning of May 2018. Pretest and post-test assessments were developed for the module and were administered to students before the program began and after instruction was completed. The study was conducted with a total of 139 grade 7 and 8 students.

In addition to analyzing the gain scores for the total group of students, analyses were conducted separately for higher and lower scoring students. Higher and lower scoring students were identified based on the students' pretest scores. Those scoring highest on the pretests were designated as the high scoring students and those scoring lowest on the pretests were designated as the lower scoring students.

The average gain scores for the total group of 139 students were statistically significant. The effect size for the total group was medium. The scores for the low and high pretest scoring groups also increased statistically significantly and the effect sizes for both groups were classified as large.

For the total group as well as both the low and high pretest scoring groups, the effect sizes were large. The effect sizes for the total group and for both high and low pretest scoring groups were above the level considered to be substantively important.

Overview of the Study

Houghton Mifflin Harcourt Publishing Company contracted with Educational Research Institute of America (ERIA) to conduct a study to evaluate the effectiveness of an instructional module of the *HMH Science Dimensions*™ © 2018–2019 Middle Grades Program. The module was entitled Ecology and the Environment and is one of 12 modules that constitute the total grade 6 to 8 instructional program. Two teachers agreed to try out the module. Neither of the teachers had previously used the program. The units, Unit 1: Matter and Energy in Living Systems, Unit 2: Relationships in Ecosystems, and Unit 3: Ecosystems Dynamics, was used by the teachers from the beginning of January 2018 until the beginning of May 2018.

A pretest and post-tests were developed for the module. Pretests were administered prior to the time the teacher began using the chosen module and post-tests were administered after instruction for the module was completed. Teachers took about twelve weeks to complete the module and the assessments.

Research Questions

The following research questions guided the design of the study and the data analyses:

- Does the implementation of a single module in the *HMH Science Dimensions: Middle Grades Program* lead to improved student knowledge and understanding of the objectives of the units of study?
- Does the implementation of a single module in the *HMH Science Dimensions: Middle Grades Program* lead to improved student knowledge and understanding of the objectives of the units of study for higher pretest scoring students as well as for lower pretest scoring students?

Design of the Study

The design of the program called for the implementation of a single module of the *HMH Science Dimensions: Middle Grades Program* during the second semester of the 2017-18 academic year. Two teachers in two different schools participated in the study.

Both teachers completed a survey regarding program usage. Both teachers reported using the program 5 days a week for 45 to 50 minutes per day.

Program Overview

The *HMH Science Dimensions*™ © 2018–2019 Middle Grades program is described by the publisher as follows:

An all-new, complete solution for the Next Generation Science Standards (NGSS)¹ is thoughtfully crafted to incorporate 3 dimensions of Learning and Performance Expectations (PEs) into every lesson, every activity, every video – every piece!

¹ Next Generation Science Standards and logo are trademarks of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product.

What sets HMH Science Dimensions apart?

Three-Dimensional Learning. *Designed – not aligned – around the Three Dimensions of Science Learning: Disciplinary Core Ideas (DCIs), Cross Cutting Concepts (CCCs), and Science and Engineering Practices (SEPs)*

Professional Support from HMH. *Simplifying your transition to an NGSS curriculum every step of the way*

Active Learning. *Activities, investigation, and evidence-gathering at the foundation of every lesson*

Integrated Engineering & STEM. *Developing students who are experts in the engineering design process*

Digital-First Flexibility. *Immersive learning experiences that engage students in doing science*

Embedded Assessment. *Preparing students to succeed on high-stakes performance-based assessments*

The program includes a total of 12 modules that cover grade 6 to 8. Each module includes 2 to 4 units.

The content outline for the total 6 – 8 program is listed below.

Module A Engineering & Science

Unit 1 Introduction to Engineering and Science

Unit 2 The practices of Engineering

Module B Cells & Heredity

Unit 1 Cells

Unit 2 Organisms as Systems

Unit 3 Reproduction, Heredity, and Growth

Module C Ecology & the Environment

Unit 1 Matter and Energy in Living Systems

Unit 2 Relationships in Ecosystems

Unit 3 Ecosystems Dynamics

Module D The Diversity of Living Things

Unit 1 The History of Life on Earth

Unit 2 Evolution

Unit 3 Human Influences on Inheritance

Module E Earth's Water & Atmosphere

Unit 1 Circulation of Earth's Air and Water

Unit 2 Weather and Climate

Module F Geologic Processes & History

Unit 1 the Dynamic Earth

Unit 2 Earth through Time

Module G Earth & Human Activity

Unit 1 Earth's Natural Hazards

Unit 2 Resources in Earth Systems

Unit 3 Using the Resources
Unit 4 Human Impacts on Earth Systems

Module H Space Science

Unit 1 Patterns in the Solar System
Unit 2 the Solar System and Universe

Module I Energy & Energy Transfer

Unit 1 Energy
Unit 2 Energy Transfer

Module J Chemistry

Unit 1 the Structure of Matter
Unit 2 States of Matter and Changes of State
Unit 3 Chemical Processes and Equations
Unit 4 The Chemistry of Materials

Module K Forces, Motion, & Fields

Unit 1 Forces and Motion
Unit 2 Electric and Magnetic Forces

Module L Waves & Their Applications

Unit 1 Waves
Unit 2 Information Transfer

Module C was the unit chosen for this study.

Description of the Assessments

The pretest and posttest used in the study were developed by ERIA curriculum experts. Tests were developed to match the content of the module used in the study.

Table 1 provides a summary of the pretest and post-test statistics. The table shows that the reliabilities of the tests are high and provide adequate stability to assess achievement of the content of the unit.

Table 1
Pretest and Post-test Statistics

Module C Ecology & the Environment	Mean Standard Score	Standard Deviation	KR 20*	SEm**
Pretest	283	41.5	.65	24.6
Post-test	317	52.3	.81	13.4

*KR 20 stands for Kuder-Richardson 20 measure of internal-test reliability

**SEm stands for Standard Error of Measurement.

Description of the Study Sample

Table 2 provides the demographic characteristics of the schools included in the study. It is important to note that the school data does not provide a description of the make-up of the classes that

participated in the study. However, the data does provide a general description of the schools and an estimate of the make-up of the classes included in the study.

The percentage of students classified as minority students (non-Caucasian) averaged 37%, and the percentage of students enrolled in free/reduced lunch programs averaged 35%. By comparison, the National Center for Educational Statistics reports that approximately 48% of the students enrolled in U.S. public schools are classified as non-Caucasian, and the reported national average for students enrolled in free/reduced lunch programs in public schools is reported as approximately 52%.²

Table 2
Demographic Description of the Schools Included in the Study

	State	Location	Grades	Enrollment	% non-Caucasian	% Free/Reduced Lunch
1	NJ	Suburb: Large	5-8	399	32%	30%
2	WI	Rural: Remote	7-12	326	10%	41%
Averages				363	37%	35%

² The National Center for Educational Statistics (NCES) reported that for the 2014-2015 school year, 51.8% of public school students were enrolled in free/reduced lunch programs. Also, the NCES reported that for the 2014-2015 school year, 48% of public school students were classified as minority (non-Caucasian) students.

Data Analyses and Results

Standard scores were used for the data analyses. Raw scores were converted to standard scores with a mean of 300 and a standard deviation of 50. Data analyses and descriptive statistics were computed for the students' standard scores.

Paired comparison *t*-tests were used to determine if differences in pretest and post-test scores were significantly different. The $\leq .05$ level of significance was used as the level at which differences would be considered statistically significant.

In addition, effect size (Cohen's *d*) was computed for each of the comparisons. This statistic provides an indication of the strength of the effect of the treatment regardless of the statistical significance. The interpretation of Cohen's *d* statistic as guided by the American Institute for Research (AIR) states that According to guidelines from the *What Works Clearinghouse*, an effect size of .25 or greater is "substantively important." Beyond the level considered to be substantively important. Interpretations of effect sizes in this report include the following guidelines:

.20 to .49 = small

.50 to .79 = medium

.80+ = large

Table 3 shows that the average scores of the 139 students participating in the study increased at a statistically significant level. The effect size was substantively important and is classified as medium.

Table 3
Paired Comparison *t*-test Results
Pretest/Post-test Standard Score Comparisons

	<i>Number Students</i>	<i>Mean Standard Score</i>	<i>SD</i>	<i>t</i> -test	<i>Significance</i>	<i>Effect Size</i>
Pretests	139	283	41.5	9.319	$\leq .0001$.720
Post-tests	139	317	52.3			

The total group of 139 students was divided into two equal sized groups based on their pretest scores. The 69 students scoring lowest on the pretests were considered lower achievement students while the 70 scoring highest on the pretests were considered higher achievement students.

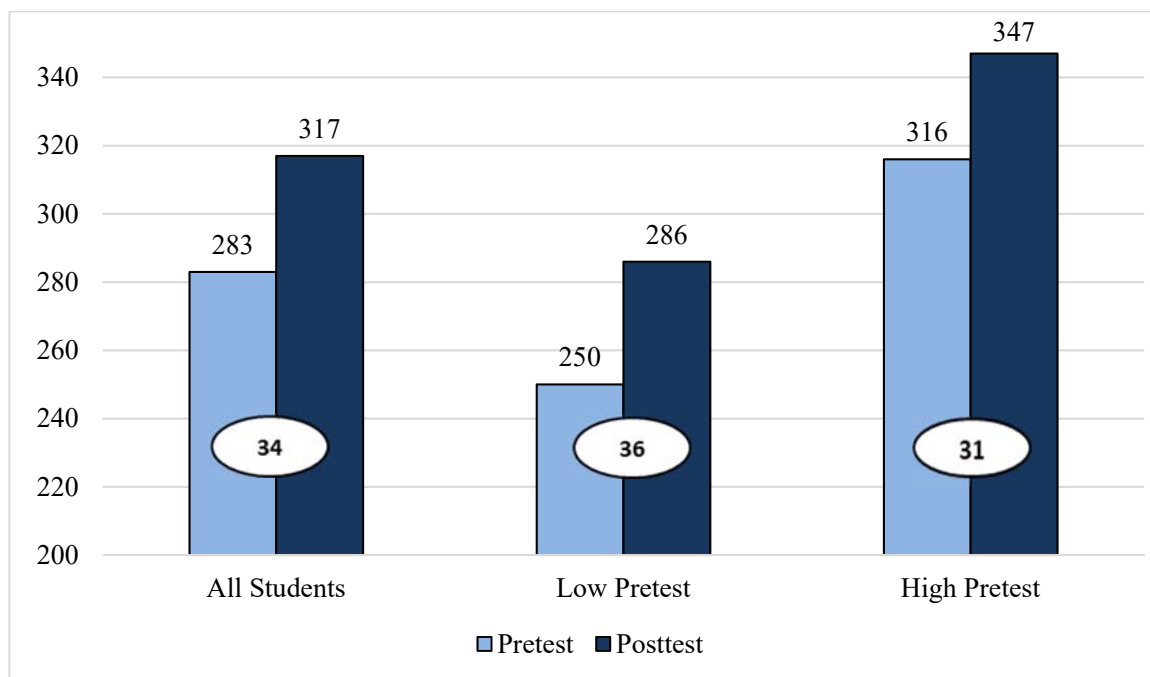
Table 4 shows that both the low pretest scoring group and the high pretest scoring group made statistically significant gains. *The effect sizes for both groups were substantively important and were classified as large.*

Table 4
Paired Comparison *t*-test Results
High- and Low-Scoring Pretest Groups

	<i>Number of Students</i>	<i>Mean Standard Score</i>	<i>SD</i>	<i>t-test</i>	<i>Significance</i>	<i>Effect Size</i>
Lower Scoring Group						
Pretest	69	250	23.0	6.166	≤.0001	1.013
Post-test	69	286	44.7			
Higher Scoring Group						
Pretest	70	316	26.3	7.301	≤.0001	.917
Post-test	70	347	39.8			

Figure 1 provides a graphic representation of the gains achieved by the students. In a twelve- week period, using assessments focused on just one module of instruction, the total group of students scores increased their average standard score by 34 points. The low pretest group increased their average standard score by 36 points and the high pretest group increased their average standard score by 31 points.

Figure 1
Pretest/Post-test Gain Comparison
All Students, Low Pretest Students, High Pretest Students



Conclusions

This study sought to determine the effectiveness of the *HMH Science Dimensions: Middle Grade Program* based on a single module of instruction. The study took place during the second semester of 2017-2018 academic year and was carried out by two teachers in two schools located in two states. The student population included about a 10% smaller average percentage of non-Caucasian students (37%) than the national average (48%). The average percentage of students eligible for free-reduced price lunch programs (35%) was lower by a little more than 15% of the national average (52%).

Research Question 1

- Does the implementation of a single module in the *HMH Science Dimensions: Middle Grade Program* lead to improved student knowledge and understanding of the objectives of the units of study?

Student achievement growth from pretesting to post-testing increased statistically significantly. The effect size was medium and above a substantively important level.

Research Question 2

- Does the implementation of a single module in the *HMH Science Dimensions: Middle Grade Program* lead to improved student knowledge and understanding of the objectives of the units of study for higher pretest scoring students as well as for lower pretest scoring students?

Student achievement growth for the high achieving and low achieving students increased statistically significantly. Both the high and low pretest scoring students effect sizes were above a substantively important level and the increases were classified as large.

For this tryout study, both research questions can be answered positively:

The *HMH Science Dimensions: Middle Grade Program* produced statistically significant increases based on pretest/post-test scores designed to assess the students' knowledge and understanding of the program. For all comparisons, the effect sizes were large and were much above the substantively important levels.