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Indiana Science Initiative Update: TERC Evaluation Report: The Impact of the Indiana Science Initiative on Students' Science Knowledge Evaluation

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Indiana Science Initiative

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Evaluation Report
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The Impact of the Indiana Science Initiative on Students' Science Knowledge

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The Indiana Science Initiative (ISI) focuses on improving instruction by providing teachers with research-based curricular materials (science kits) that support guided inquiry, and training them to use these kits effectively. ISI professional development and curricula at each grade level are aligned to state science standards, a notebooking process is integrated to support science practices as well as literacy, and mathematical ideas are explored in some of the science kits.

Acuity assessments, developed by CTB McGraw Hill, provide diagnostic measures for grade 3-8 students in all subject areas. The assessments are aligned to the Indiana standards and designed to support an educator's ability to inform instruction at the student, class, school, and corporation level. While not explicitly tied to the science curricula used by the ISI teachers, the ISI team and TERC evaluators felt this instrument would adequately measure science content knowledge gains as a result of ISI. Thus, this study measured:

- increases in student achievement for ISI students on Acuity physical, earth/space, life science, and technology/engineering assessments.
- the extent to which ISI supports equity in these areas of study.

Research Methods

Data: There is no state requirement for schools to use Acuity assessments. Therefore, the study relied on available 2012-13 Acuity data for grades 3-8 that could be secured from the Indiana Department of Education by the ISI Research Associate. Data were organized within four science standards, each of which covered a science discipline: physical, earth/space, life, and technology/engineering. The ISI Research Associate merged teacher and student data, identified which teacher IDs were associated with ISI, and stripped all names from the set (to adhere to human subjects protections). In order to examine the impact of ISI, TERC evaluators employed a quasi-experimental design using nearest neighbor propensity score matching. Matching was done at the school level, and was based on student demographics and school size. This process resulted in a sample of 42 ISI classrooms and 41 comparison classrooms that did not use science kits. On average, there were 19 students per classroom.

Analysis: For each of the four science standards, we developed hierarchical linear models (HLMs) to account for the fact that students were nested within teachers' classrooms. Student-level characteristics were entered into the model. These included:

Race (coded as white and nonwhite)
Gender (coded as male or female)
Free/Reduced Lunch (coded as no FRL and qualifies for FRL)
Exceptionality/special needs (coded as no exceptionality and identified exceptionality)

From these models, we determined which student-level characteristics were associated with Acuity scores, and also, we determined which random effects were statistically significant. Only student characteristics and random effects that reached statistical significance were retained in subsequent models.

In a second step, teacher-level characteristics were added to the model. These included:
ISI (coded as ISI teachers or comparison teachers)
Grade (coded as elementary school or middle school)

Study Results

Initial testing

This testing was conducted to determine whether each student group needed to be analyzed separately by race, gender, FRL, and exceptionality. Similarly, we tested whether Acuity scores differed for students in elementary versus middle school grade levels.

- *student characteristics:* Although some student characteristics were associated with Acuity assessment scores, none of the random effects were significant. Because of this, we could measure the effect of ISI on all students in one model for each standard, EXCEPT for gender in standard 2 (see findings for Standard 2, below).

- *grade level:* Acuity scores didn't differ systematically by grade level. Therefore, we could measure the effect of ISI on both elementary and middle school students in one statistical model for each standard.

Findings for Standard 1: Physical Science

Elementary and middle school students in ISI classrooms had *significantly higher Acuity scores in physical science* as compared with students in non-ISI classrooms. This statistically significant positive effect ($t(59)=2.42$, $p = 0.02$) was true for boys and girls, students of all races, and for those with and without FRL status and identified exceptionalities.

ISI professional development focusing on physical science content and instruction followed by classroom implementation of physical science kits began in the summer of 2010. Thus, many ISI teachers had several years to develop knowledge and skill as well as to increase the amount of physical science instruction in their classrooms. Findings suggest this was beneficial to student learning, as measured by the Acuity assessment.

Findings for Standard 2: Earth and Space Science

*Elementary and middle school **female** students in ISI classrooms had significantly higher Acuity scores in earth and space science* as compared with female students in non-ISI classrooms.

- This positive effect ($t(32)=1.89$, $p = 0.059$) was true for female students of all races, and for those with and without FRL status and identified exceptionalities.
- While there was *not* a statistically significant difference between ISI and comparison group male students, there was a *positive data trend* (an overall higher score) for ISI elementary and middle school boys of all races, and for those with and without FRL status and identified exceptionalities ($t(32)=1.68$, $p = 0.102$).

In our analysis of Standard 2 scores, gender matters. Males in grades 3-8 in both ISI and comparison classrooms scored higher than their female counterparts. However, *being a girl in* *an ISI classroom mitigates this gender difference and helps to close the gender gap in earth and space science knowledge*.

Most ISI teachers participated in earth and space science PD followed by kit implementation in 2011, two years prior to the collection of this set of Acuity data, once again giving teachers more time and opportunities to gain knowledge and implementation experience. Findings suggest this was beneficial to student learning.

<u>Findings for Standard 3: Life Science & Standard 4: Technology and Engineering</u>

We report on these two standards together, as results were the same for each one. *There was no statistically significant difference in Acuity scores for elementary and middle school students in ISI classrooms in life science* ($t(74)=0.26$, $p = 0.80$) *or in technology and engineering* ($t(82)=0.38$, $p = 0.70$) as compared with students in non-ISI classrooms. This was true across all student groups.

Such a finding for life science and technology/engineering was not especially surprising, given that ISI professional development and kit implementation in these two areas began just prior to the 2012-13 school year when these Acuity data were collected. Thus, there was limited time in which teachers could translate learning from ISI professional development into practice, and for many, it was the first year they instructed with an ISI life science kit or conducted investigations in technology/engineering.

Furthermore, with limited curricula available specifically for technology and engineering for the elementary and middle grades, ISI supported teachers in meeting the goals of Standard 4 via investigations in the physical, earth/space, and life science kits. As a result, there may have been less focus on or time to explore technology and the engineering design process as fully. Given students lack of familiarity with the engineering as compared with other areas of science, more emphasis on engineering may be needed.

Conclusion and Next Steps

These analyses suggest that ISI professional development, curricular materials, and instructional strategies support teachers in offering a richer educational experience that impacts their students learning of physical and earth/space science concepts. In particular, ISI is making an important contribution to girls in earth/space science—an area where women often do not perform as well. Because it may have been too early to see the effect of ISI on student learning in life science and technology/engineering, further study should be conducted. More time to develop content knowledge and instructional expertise in these areas may enable teachers to influence student learning outcomes across all of four content standards.

Additionally, we believe a longitudinal study that measures student change over multiple years will provide a fuller look at the trajectory of growth for various student groups who receive consistent ISI instruction over time. This study may also show the accumulated impact of ISI as students explore science ideas in increasingly greater depth as they move to higher grade levels.

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