THE EFFECT OF THE SCIENCE WRITING HEURISTIC ON THE ANNUAL IOWA ASSESSMENT STANDARDIZED EXAM SUBSECTIONS, A LONGITUDINAL STUDY.

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ABSTRACT

A longitudinal analysis of the annual Iowa Assessment standardized exams is used to evaluate the effect of the Science Writing Heuristic (SWH) learning approach on student performance. A multilevel linear mixed effects model is used to evaluate the improvement in national standardized subject test scores in Science, Mathematics and Reading. Students in schools teaching science using the SWH approach have had significant improvements in all three subject tests when compared to students in the control schools.

SCIENCE WRITING HEURISTIC (SWH)

SWH is an inquiry based learning approach that targets improving students' understanding of science by embedding science argument within typical inquiry lessons. This promotes critical thinking and science reasoning into the inquiry approaches, using language to negotiate students' understanding of science. Students are required to pose questions, generate claims and evidence, compare their answers with other students and reflect on changes in their understanding. Finally they put this in written form which improves their English and reasoning abilities.

TEACHER TESTIMONIALS

"This program not only helps students LOVE science, but it also helps them to become better people through improving communication skills that 'the old way' missed, where students memorized facts and took a test! I'm excited to use this in my classroom!"

"It's amazing how engaged students are, the connections they make with reading and other content areas, and the discussions they are able to have. Students are also used to providing claims/evidence through the use of CGI in math, and I'm seeing it in reading too. It's just natural to ask students to back themselves up with evidence when they claim to see a context clue, a text structure, or a synonym of a vocabulary word."

"I have NEVER seen kids more excited about learning our Social Studies content due to our instructional approach of entering from the lens of a big idea. It is no longer just about memorizing."

ADMINISTRATOR TESTIMONIALS

"Our kids have been given the choice of going back to science the way we used to teach it and SWH. There is not one student who wants to go back. Their level of engagement is off the charts. It's one of the best initiatives we have undertaken in all of my professional career. I highly recommend any school to implement SWH. You will notice a difference in all academic areas including improvement in behavior."

"I have noticed a tremendous difference in our students as a result of SWH. They are so much more engaged in their learning. They actively seek out information at school. The great thing is that they are so motivated to find answers to their questions and claims that they spend time outside of school doing research and bringing it back for discussion with their peers the next day. Our parents are noticing, too. They are very positive about the interest their children are showing."

"Another really great thing is that our kids who have struggled learning in the past are particularly doing well. They succeed at SWH. They have knowledge that isn't always evident in a traditional science class where the teacher is the expert. They get to share and test their claims and often they are right."

MULTI-LEVEL MODEL

Students in Iowa are annually tested in multiple subject areas. These scores are then equated to a national standardized scale by Iowa Assessments. The national standard scores in Mathematics, Science, and Reading were used as the response in the longitudinal model.

$$
\begin{aligned}
\text{Score} = \ & \text{Grade} + \text{SWH} + \text{Semester} + \text{Gender} \\
& + \text{Demographics} + \text{Socioeconomic Status} \\
& + \text{Learning Indicators} + \text{Test Change} \\
& + \text{Interactions of predictors with SWH} \\
& + \text{Interactions of predictors with Grade} \\
& + \text{Student and School Random effects}
\end{aligned}
$$

Data: 26,723 students spanning the $3^{rd}, 4^{th}, 5^{th}$, and 6th grades from 83 different schools over 6 academic school years (2006-2012).

RESULTS

Variable	Math est. (std. err)	Science est. (std. err)	Reading est. (std. err)
(Intercept)	**181.841 (0.666)**	**188.979 (0.833)**	**189.903 (0.771)**
Time	**15.841 (0.109)**	**16.52 (0.142)**	**14.299 (0.129)**
SWH	**2.768 (0.498)**	**2.774 (0.632)**	**1.900 (0.592)**
SEM	**3.465 (0.130)**	**3.835 (0.166)**	**3.849 (0.154)**
MALE	**3.386 (0.290)**	**1.678 (0.363)**	**-2.906 (0.346)**
FRL	**-3.401 (0.295)**	**-5.36 (0.377)**	**-5.747 (0.350)**
ELL	**-8.480 (0.881)**	**-11.796 (1.123)**	**-11.715 (1.069)**
GAT	**10.673 (0.499)**	**13.965 (0.648)**	**12.993 (0.591)**
IEP	**-8.502 (0.439)**	**-7.196 (0.560)**	**-14.329 (0.521)**
HSP	**-3.886 (0.777)**	**-3.182 (0.979)**	**-3.930 (0.927)**
BLK	**-10.532 (0.656)**	**-10.482 (0.826)**	**-11.110 (0.779)**
ASN	**3.170 (0.987)**	1.484 (1.247)	1.763 (1.202)
Test	**-7.771 (0.181)**	**-10.883 (0.233)**	**-8.697 (0.214)**
SWH:MALE	-0.035 (0.458)	-0.670 (0.584)	0.277 (0.545)
SWH:FRL	-0.846 (0.482)	-0.954 (0.617)	-0.699 (0.573)
SWH:ELL	1.459 (1.375)	0.807 (1.748)	-0.276 (1.669)
SWH:GAT	**2.294 (0.755)**	1.203 (0.975)	-0.741 (0.896)
SWH:IEP	0.085 (0.713)	-0.095 (0.912)	-0.877 (0.848)
SWH:HSP	0.005 (1.179)	-1.536 (1.498)	-0.098 (1.408)
SWH:BLK	-0.797 (0.992)	-0.034 (1.259)	**-3.607 (1.177)**
SWH:ASN	0.291 (1.595)	-0.085 (2.029)	-2.218 (1.929)
Time:SWH	**0.591 (0.254)**	-0.447 (0.325)	**1.006 (0.302)**
Time:MALE	**0.388 (0.109)**	**0.942 (0.142)**	**0.447 (0.130)**
Time:FRL	**-1.157 (0.126)**	**-0.828 (0.163)**	**-0.683 (0.149)**
Time:ELL	**-1.235 (0.365)**	**-2.269 (0.472)**	**-1.794 (0.441)**
Time:GAT	**2.786 (0.208)**	**3.202 (0.272)**	**2.556 (0.247)**
Time:HSP	-0.081 (0.305)	-0.391 (0.394)	-0.038 (0.362)
Time:IEP	**-3.825 (0.181)**	**-4.269 (0.234)**	**-3.618 (0.214)**
Time:ASN	**2.442 (0.392)**	0.434 (0.511)	**1.435 (0.472)**
Time:BLK	**-0.674 (0.246)**	**-1.761 (0.318)**	-0.156 (0.291)

Bolded coefficients indicate the effect was significant at the 0.05 level.

CONCLUSIONS/FINDINGS

Key findings from the Multilevel Model results:

1. SWH has had a positive increase in Math, Science and Reading standardized test scores.
2. Nearly every subgroup of students benefits from SWH.
3. Significant disparities in test scores exist by third grade.

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