Improving Student Achievement in Science with the Interactive Student Notebook

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Abstract

This action research project investigated the effectiveness of using a science interactive notebook to aid in increasing student achievement in science as the primary instructional tool. The project involves nineteen eighth grade students who have exhibited prior challenges with meeting proficiency with various scientific concepts, as measured through their fifth grade science TAKS scores, as well as the district assessments taken in both sixth grade and seventh grade. By utilizing the science interactive notebook, students will apply their understanding of the concept taught on the left-hand side of the spiral notebook. The left-hand side is the students' individual accounting and understanding of a specific concept and will exhibit a variety of learning modalities that include, but are not limited to concept maps, Venn diagrams, poems, charts, tables, short stories, et cetera. Whereas, direct instruction via Cornell notes, guided practice, whole group and small group discussions of the scientific concepts presented will appear on the right-hand side of the spiral notebook. Based on the April administration of the Texas Assessment of Knowledge and Skills (TAKS test), the results are encouraging and suggest that the science interactive student notebook as a primary instructional tool was effective. By creating and applying their own understanding of scientific concepts within the interactive notebook, the students were able to demonstrate proficiency of those varied scientific concepts not only in their interactive notebook, but also on the high-stakes TAKS test.

Background/Context

As part of the campus improvement plan and a genuine desire to raise student achievement in science, avenues were explored to attain significant gains in our campus TAKS science scores, with particular increases in two subpopulation groups: African-American students and economically disadvantage (free/reduced lunch) students. For the past two years, increasing science achievement has been on the forefront; however, very little gain was realized on the researcher's campus. In the researcher's first year with working with the eighth grade science team and the students, there was a two-percentage point increase in the TAKS science score from the previous year. The anticipated goal was to obtain a minimum increase of ten-percentage points. The traditional methods (textbooks and worksheets) practiced on campus for science learning were not proving as lucrative as it had in years before. While science was showing few improvements, the math scores had considerable increases in its

TAKS scores. For both core content areas, the students had the same amount of instructional time in the classrooms, as well as content-rich tutorial programs. However, the math program had one caveat that the science program did not have: a TAKS math class that served as an elective for those students who had not been successful with passing the math TAKS in seventh grade. Although middle school science is only tested at eighth grade, the researcher wondered if incorporating a TAKS science class that utilized an interactive notebook as the primary resource could provide the desired goal of significantly increased TAKS science scores. This action research project focuses on how the implementation of the interactive notebook (IAN) can improve students' performance not only in the science classroom, but also by improving achievement on the high-stakes TAKS science assessment.

Students who are able to communicate their science experiences by making connections with the various scientific concepts strengthen their learning. As a tool, the IAN would allow students to write, draw, and reflect their thinking and understanding of learned science concepts. In essence, the students are creating their own personal science textbook that is written in a language that they understand and in a format that is designed by them. As students' understanding of science information progresses, improvement should also be seen in science achievement.

The research question of this study is to explore the effectiveness of the interactive notebook in science and the impact that the notebook can have on the students' achievement in science, especially with respect to the end of the year TAKS science assessment. To assess the effectiveness of the science interactive notebook, a new elective class, known as TAKS Science, was created in which the students would strictly use the interactive notebook as the primary resource for their learning. The student population to be observed is a class of nineteen eighth grade students. The students were selected based on several criteria that were in alignment with the campus improvement plan, which included increased science achievement in two subpopulation groups: African-American students and economically

disadvantaged students (free/reduced lunch, F/RL, program). Additional criteria were past performance on the students' fifth grade TAKS science test, as well as the student scores from the fall and spring district assessments in sixth, seventh and eighth grades. Selected students were the "bubble students," meaning that without strategic intervention, these students could fall below proficiency or further. The TAKS Science class was comprised of eight females and eleven males. Eighteen of the students are African-American; and one student is Hispanic. Eighteen of the students are participants in the campus free/reduced lunch program. One student had just exited from the free/reduced lunch program.

The interactive notebook concept is important to the researcher because as a former chemical lab researcher, the IAN mimics the real-world practice of scientists around the world, which is the use of a lab notebook to document information and findings; to test the validity of the information and/or findings; to record data; and to make informed decisions based on the analysis and the evaluation of the data. Students need to know that writing about science, whether it is through drawings, poems, songs, letters, games, or other forms of prose is a way to learn about science and to dispel misconceptions.

Research on Interactive Notebook

In order to have a true understanding of science, students must be able to do science. Students must be able to experience various science modalities in order to form meaningful connections. The IAN can help facilitate student learning. Bain (2006) suggests that the way you learn does not matter when you use an interactive notebook. Bain (2006) acknowledges that people learn in different ways: some learn by watching others; some learn better by reading; and some learn by doing. However, any of these learning modalities can be incorporated into an interactive notebook that is specifically designed by the individual student and how he or she processes information.

Young (2003) takes it a step further and states that writing is one of the ways that students learn in science and that the interactive notebook is the tool that can be used to strengthen student learning of

curriculum through increased student output. The key to the interactive notebook lies within the set-up. The IAN uses both the left- and right-side pages, just as students use both left- and right-sides of the brain. For the interactive notebook, the right-side is used for input such as notes from lectures and whole group and small group discussions; labs, such as the problem, hypothesis, procedures, et cetera; as well as teacher directed activities. The left-side of the IAN is student-created. On the left-side is where the student would apply his or her own understanding of what the right-side addresses. The left-side is output; it can have drawings or cartoons made by the student; collecting and recording data, creating tables and charts, and writing conclusions for labs; and other forms of narrative and expository writings.

Gilbert and Kotelman (2005) also support that expository writing skills are further enhanced by the students within science notebooks. For this action research project, students used a variety of expository writing to further promote their learning of science concepts. In the lab safety unit, students used narrative writing to explain what went wrong in the science lab to change a scientist into a "lab-rador." For a unit on lab equipment, students used descriptive writing and labeling to construct and categorize a concept map. Students had the freedom to sort and categorize types of lab equipment according to their understanding. Students also used procedural writing in their IAN by designing a controlled experiment in the "Glow Stick Lab." Additional forms of expository writing that may be found in the students' interactive notebooks include explanatory writing and persuasive writing. Gilbert and Kotelman (2005) further elaborate that as a tool, the interactive notebook encourages students to write for thinking and empowers the students to become active in their own learning.

According to Hargrove and Nesbit (2003), science notebooks expose students' thinking and provide the teacher with important insights about student understandings. This researcher was able to gauge students' understanding of science concepts by interfacing with students as they articulated and

answered questions about concepts that were covered at that time. What was very encouraging were the personal connections the students were making with the concepts. This was also a grand opportunity to see what the students did not understand and any misconceptions they may have had that needed to be addressed. The more students understood the science concepts, the more knowledgeable they became with the science topic. In El Centro, California, Hargrove and Nesbit (2003) also found that teachers who had implemented science notebooks had made impressive gains on standardized tests in science. This research project focuses on the increase of student achievement in science through the use of the interactive notebook.

Methodology

Participants

Nineteen eighth grade students, eight (8) female and eleven (11) male, participated in this action research. The students' science achievement scores on average for standardized state testing ran the gamut of just above proficiency to just below or moderately below proficiency. For district assessments, the scores ranged from low need to high need. Eighteen of the nineteen students in the study are African-American, as well as economically disadvantaged (participated in the free or reduced lunch program). One of the eighth grade students is Hispanic and had recently exited the free/reduced lunch program. One of the eighteen African-American students was withdrawn from school and was no longer a participant of this research due to health reasons.

Materials

The materials used were a spiral bound notebook (70 pages); glue, tape, pens, pencils, colored pencils, crayons, markers, rulers, pre-cut sheets of paper that are glued in the notebook. The spiral notebook is set-up by the students with the classroom instructor also modeling the set-up process. Each page of the notebook is numbered front and back. No pages were allowed to be ripped out of the notebook.

Procedures

Students who participate will utilize the interactive notebook on a daily basis. Each science topic will be broken down into units of study. Each unit of study contains a "cheat sheet" on the left that is student generated of any new information learned about the topic, as well as any facts, formulas, ideas or vocabulary words that resonate with the student. Along with the "cheat sheet" on the left, each unit of study will have a table of contents on the right. The table of contents is set-up as a modified t-chart with the column to the left to reflect the page number and activities on the left-side of the notebook. Conversely, the column to the right of the t-chart represents the page numbers and teacher-directed notes on the right. The table of contents was updated daily.

The teacher-directed notes utilized modified Cornell notes, in which the teacher formulated some pre-determined questions and answers for the students. Students were allowed to write additional questions that they may have had concerning the topic at hand. Along with the Cornell notes, students had the opportunity to practice in small group or whole group the concept learned. Continuous teacher observations and whole group student discussions were indicators of student progress. After a clear understanding of the science topic had been observed by the teacher, time was allocated for the students to summarize in their own words the topic covered that day underneath the Cornell notes.

Initially, as students learn the interactive notebook process, the teacher will provide the type of activity for the student to demonstrate on his or her own on the left-hand side. As students develop mastery, the teacher may elect to do a menu selection for the students to choose from to demonstrate understanding of the right-hand side material.

Generally, one right-side and one left-side page were completed each day. No interactive notebooks were kept in the classroom. These notebooks were the responsibility of the student. Time was allowed in each class meeting for students to work in their interactive notebook. However, if students wanted to work in their notebooks at home, they could do so.

It is also important to note that the teacher did maintain a master copy of the interactive notebook. The master copy did not contain any answers, but did have the skeletal outline of the information covered on the right-hand side and the type of demonstration of understanding on the left-side of the interactive notebook.

Data Sources

Two principal instruments were used to measure the results of this project: TAKS science scores from fifth grade and eighth grade and the middle school science district assessments (DAs). The data collected will be to see if the interactive notebook helped students to connect and understand the various science concepts; and ultimately to improve the students' achievement in science. The real litmus test for the effectiveness of the interactive notebook lies within the students' performance on the April administration of the eighth grade TAKS science test.

The middle school science district assessments (DAs) will be administered twice. The first administration will occur in November; and the second administration will occur in March. Both DAs will be used for formative assessment purposes only, in which to further gauge the students' understanding of the concepts covered in the interactive notebook. The middle school science district assessment is an assessment used in the district to aid in planning, monitoring, and adjusting instruction as needed to maximize student achievement. The DA is a selected response assessment which tests the students' mastery of the power standards, which are prioritized TEKS (Texas Essential Knowledge and Skills).

The TAKS science test will be administered in late April. This test is a standardized assessment to measure students' science skills based on the Texas science education standards. The TAKS science test is also a selective response assessment.

Data Analysis

The researcher will mainly use the district assessments for grades sixth, seventh and eighth, as well as the TAKS Science scores from fifth and eighth grades for data analysis. The scores of each will be charted and analyzed to see if the interactive notebook improves students' comprehension of scientific concepts. The average scores of these assessments will be presented in graph form to determine the effectiveness of the teaching strategies used with the interactive notebook. Along with the actual average student scores of the district assessment, a linear regression analysis was charted and analyzed to predict what the impact would be if the interactive notebook was not utilized in the classroom and the effect on student achievement.

Analysis/Findings

District Assessments

The charts below show the students' district assessment scores. Figure 1 represents the forecasted trend of the district assessment scores without the science interactive notebook as the primary learning tool in grade eight. Figure 2 represents the actual district assessment scores with the science interactive notebook utilized in grade 8. Individual student scores can be viewed in *Appendix A.*

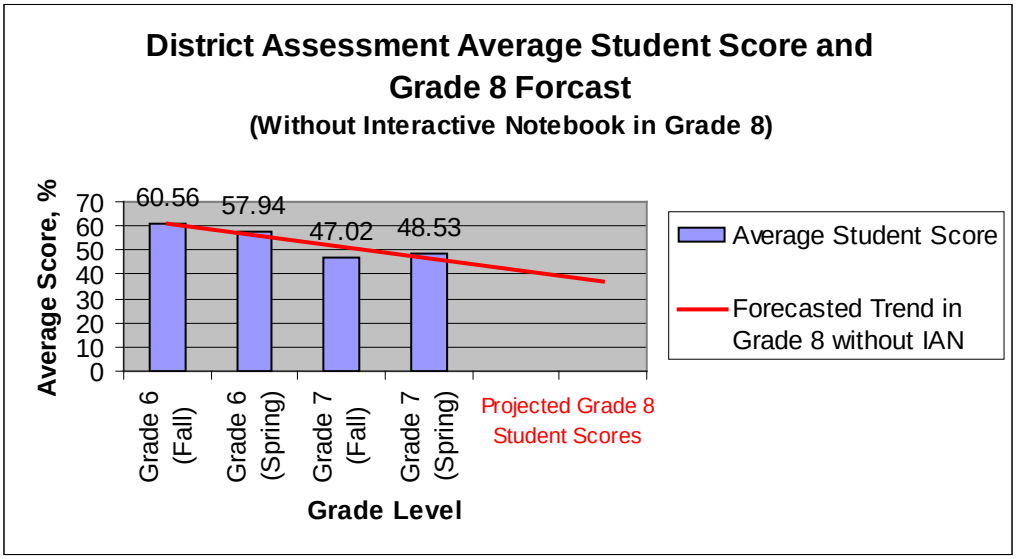

Figure 1. Forecasted trend of student scores on district assessments.

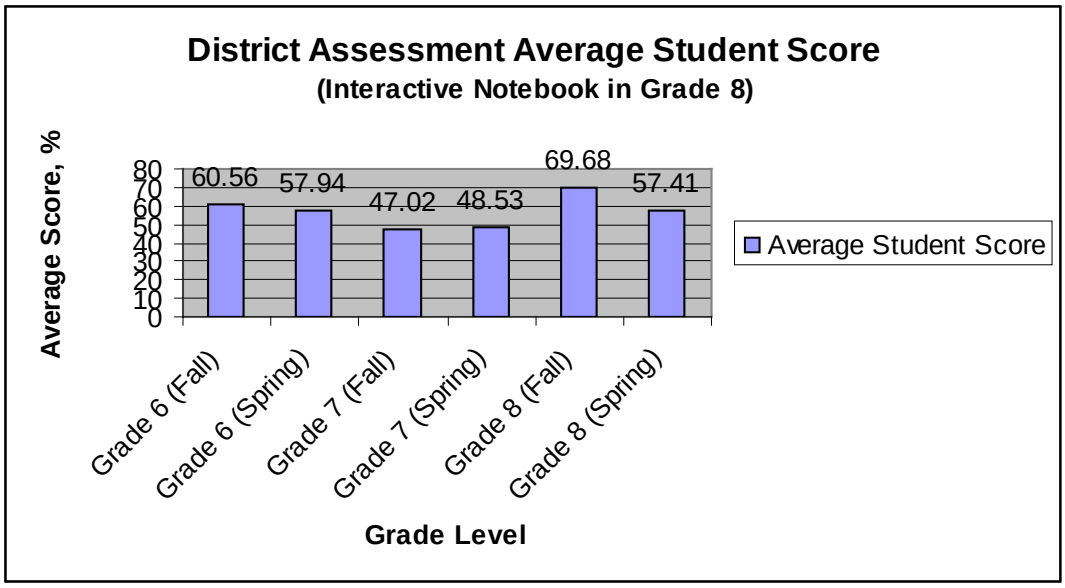

Figure 2. Student scores on district assessments.

With the implementation of the science interactive notebook in grade 8, student scores show improvement from the previous two grade levels. Before the science interactive notebook, students' level of mastery of science content was regressing. In contrast, students' scores had increased significantly in grade 8 than in the previous seventh grade year. The researcher also noticed that the level of mastery decreased during the spring administration of the DA, save grade 7 in relation to the fall administration of this assessment.

TAKS Test – Science

The student TAKS Science scores are shown in this graph below. The fifth grade administration came before the research of this project. The eighth grade administration occurred while this project was active. Individual student scores can be viewed in *Appendix B.*

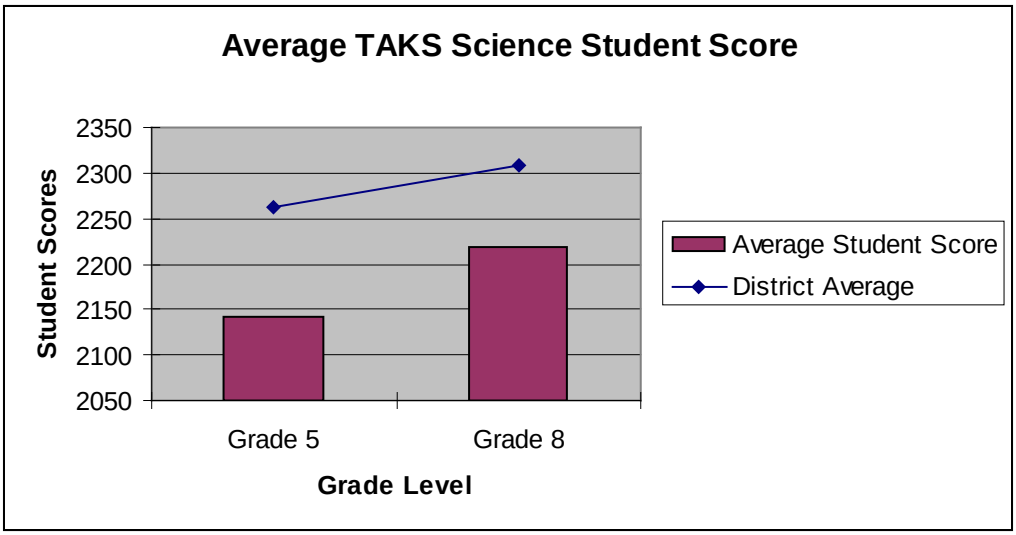

Figure 3. Student scores on TAKS Science.

There is only one administration of the TAKS science test. The average TAKS science score of the students when they were in fifth grade was below the average of the district prior to this study. After the eighth grade TAKS science administration, the researcher found that although the students' average score is still below the district average, the gap between the students score and the district average is narrowed. This progress shows that the interactive notebook had a positive impact on the science learning of the students which in turn affected the students' overall achievement scores.

Discussion

The researcher is confident that creating a TAKS Science class that incorporated the science interactive notebook as the primary learning tool has increased the scores on the district assessments, as well as with the end of the year TAKS science test. Before the utilization of the interactive notebook, students demonstrated little mastery of the science concepts that were taught. After implementing the science interactive notebook, students performed significantly higher on the eighth grade district assessments and grade eight TAKS science test.

Although an increase in students' district assessment scores and TAKS science scores may be correlated with students' usage of the science interactive notebook, the researcher does acknowledge at

least one limitation of this study. The district assessment scores and TAKS science scores can be affected by many other classroom practices, which is why this researcher cannot exclusively relate the increase in scores to the interactive science notebook. However, the students' increased mastery of the science concepts expectedly is the foremost contributor to the increases achieved in the eighth grade district assessments and grade eight TAKS science test.

The relationship between mastery of science concepts and gains made in standardized testing is in agreement with the research by Hargrove and Nesbit (2003), who found that science notebooks expose students' thinking and provide insights about student understandings. It is through that inquiry-based program that implements the science notebook that Hargrove and Nesbit (2003) experienced science scores double with students in a California school district.

There was no direct comparison group used in this study, which was another limitation. Although there were two class periods that has the TAKS Science elective course, this researcher could not deny any student who wanted to participate in this study. It would be informative in future studies regarding the science interactive notebook to examine a comparison group of students who do not utilize the science interactive notebook as the primary learning tool in order to chart the levels of achievement between the two groups. The comparison of the two groups would allow researchers to closely examine the benefits of the science interactive notebook.

Reflections/Action Plan

In conclusion, this action research project demonstrated the benefits of a science interactive notebook in the classroom. The science interactive notebook noticeably exhibited advantages that can positively impact student learning of science concepts, and thus, lead to higher achievement. By allowing students to reflect and communicate their own understanding of science concepts, the students become accountable for their own learning; which can only lead to their success.

There are two actions that should be taken into consideration to further enhance student success with the interactive notebook: the inclusion of a “reflection” page and a “parent communication” page. The reflection page would allow students to select their best and worst work in the interactive notebook and express their thoughts about the selected work. This page would also serve as an opportunity for the students to identify areas of improvement when generating a final product. The parent communication page would give parents the chance to view their student’s work and to see how their student processes science information. This page would allow parents to communicate their thoughts of their student’s science progress, as well as afford parents the chance to ask their student probing questions about the work the student is doing in science.

This researcher will continue to support the usage of the interactive notebook in the science classroom. One way the researcher will further this action research project is by offering science interactive notebook training through the district’s professional development sessions. Although a small population of students was studied for this project, the researcher strong believes that all students can gain achievement in the science classroom. Through subsequent facilitation of staff development sessions promoting the use of the science interactive notebook, it is the researcher’s goal to change the face of science achievement one classroom at a time.

References

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Hargrove, T., & Nesbit, C. (2003). *Science notebooks: Tools for increasing achievement across the curriculum*. (ERIC Document Reproduction Service No. ED482720). Retrieved June 29, 2010, from http://www.ericdigests.org/2004-4/notebooks.htm.

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Appendix A - Individual Student Scores (District Assessment [DA])

Student	6h Grade Fall DA	6th Grade Spring DA	7th Grade Fall DA	7th Grade Spring DA	8th Grade Fall DA	8th Grade Spring DA
1	75.00	70.00	42.86	50	70.83	50.00
2	45.00	45.00	46.43	41.67	75.00	37.50
3	65.00	60.00	60.71	37.50	58.33	58.33
4	60.00	45.00	35.71	41.67	66.67	41.67
5	60.00	50.00	35.71	29.17	66.67	45.83
6	65.00	75.00	71.43	54.17	91.67	66.67
7	75.00	70.00	53.57	54.17	62.50	70.83
8	40.00	55.00	35.71	29.17	75.00	50.00
9	60.00	35.00	53.57	54.17	75.00	62.50
10	55.00	60.00	32.14	54.17	58.33	50.00
11	60.00	60.00	39.29	--	62.50	66.67
12	65.00	65.00	57.14	45.83	70.83	66.67
13	70.00	70.00	75.00	62.50	83.33	87.50
14	60.00	45.00	21.43	54.17	45.83	50.00
15	60.00	65.00	21.43	50.00	79.17	62.50
16	60.00	--	64.29	54.17	75.00	50.00
17	60.00	65.00	67.86	50.00	70.83	54.17
18	55.00	50.00	32.14	62.50	66.67	62.50
Student	**6h Grade Fall DA**	**6th Grade Spring DA**	**7th Grade Fall DA**	**7th Grade Spring DA**	**8th Grade Fall DA**	**8th Grade Spring DA**
Average	60.56	57.94	47.02	48.53	69.68	57.41
Campus Average	62.07	58.80	58.96	56.51	73.03	66.67
District Average	70.27	67.14	63.94	61.78	70.04	64.98

Appendix B - Individual Student Scores (TAKS Science Test)

Student	5th Grade	8th Grade
1	2037	2322
2	2118	2233
3	2037	2100
4	2100	2100
5	2118	1899
6	2263	2358
7	2220	2183
8	2149	2233
9	2183	2358
10	2149	1994
11	2118	2137
12	2118	2159
13	2183	2657
14	2062	1975
15	2118	2358
16	2220	2358
17	2220	2183
18	2149	2322
Student	**5th Grade**	**8th Grade**
Average	2142.33	2218.28
Campus Average*	Not Applicable	2337
District Average	2262.78	2307.40

*Students attended different elementary campuses within FBISD.