

THE EFFECTS OF INCREASED SCIENCE INSTRUCTIONAL CLASS TIME ON A
SECOND GRADE CLASSROOM

by

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of

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DEDICATION AND ACKNOWLEDGMENT

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ABSTRACT

Science learning time has been on the decline because of increased time spent on language arts, reading and math. Lack of supplies, equipment and support from administrators are also contributing factors. Connections between math and science seem natural. The purpose of this study was to evaluate the effect that increased science class time, enriched with mathematically based skills, had on the students' understanding of content, as well as interest, motivation and confidence in math and science. Evaluations of scores, surveys, and interviews were performed to assess results.

INTRODUCTION AND BACKGROUND

Blessed Sacrament School is a kindergarten through eighth grade Catholic elementary school located in Washington, D.C. Begun as a parish school in 1923, Blessed Sacrament School continues to primarily serve students who live in that parish, which straddles the District of Columbia and Maryland. According to Blessed Sacrament's administrative assistant, 20% of the current 526 students who attend are non-parishioners and non-Catholic. Socioeconomically, the majority of all students are middle class. Financial assistance is given to 15% of the registered families. Additionally, fewer than 10% of the students self-declare as minorities under the categories of Asian, Hispanic or Black.

I am the only science teacher for the lower school and teach 18 different classes each week. As an itinerant teacher, I travel to each class and their respective homeroom teachers sit in the back as I conduct my lessons. The kindergarten, first and second grade classes meet with me for 45 minutes per week. All classes are content filled, with vocabulary and concepts being taught and evaluated. The homeroom teachers supplement the students' science learning by incorporating the subject matter into reading and social studies.

The faculty is dedicated to instilling a strong work ethic and providing a solid base of knowledge. As Blessed Sacrament School has a religious affiliation, it has not been required to participate in mandated state or local proficiency testing. The school uses Scantron, a computer based assessment of language arts and mathematics that tracks adaptive diagnostic testing and standards-based formative assessment, to help teachers raise the level of student achievement.

Adequate time and resources, including teachers who have a depth of content knowledge, are necessary for success in science education (Cavanagh, 2007). My job as the only elementary science teacher spanning the lower school is unusual in the geographic area. One teacher who is responsible for the content matter of six grades must have both a depth and breadth of knowledge that is conducive to vertical alignment. The sequencing of subject matter and skills allow students to learn in a progressive manner thus preparing them for more challenging work. The Common Core State Standards report that teachers can take advantage of vertical alignment by building upon prior knowledge and deliberately spiraling skills to prepare for future learning. Reviewing content and reinforcing concepts is vital in preparing students for success.

A Catholic educational system appears to offer several distinct opportunities to examine science education. Evidence suggests that shared values, a sense of community, parental involvement, and self-discipline may be explained by the connectedness of a common religious commitment (Ghee & Khoury, 2008). Additionally, the school is not required to participate in any district or state mandated curriculum or class time. These factors allowed flexibility in scheduling additional class time. With the cooperation of a self-contained second grade teacher, the amount of weekly science instructional time for one of the two second grade classes was increased by 45 minutes.

One of my teaching beliefs is that science, at its core, is closely aligned with mathematics. Cavanagh (2007) suggests that teachers might encourage science lessons that demonstrate reading comprehension and use mathematics. I wanted to study and evaluate the effects that an increase in science class time had on second grade students' learning. The primary question for my action research-based project was: *Will a class*

that has increased science time be impacted in its understanding of math content in comparison to that of a class without the increased science time? An additional consideration was: Will this additional time impact students' understanding of science content? A final consideration was: Does increased science time impact student motivation and confidence in the subject of science as well as math?

CONCEPTUAL FRAMEWORK

A report from the National Research Council (2011) calls for increased participation in science, engineering and mathematics as demand for Science, Technology, Engineering and Math (STEM) related jobs increase. There is a concern that students in the United States do not perform as well in these fields as their global counterparts (Blank, 2013). This trend echoes earlier calls to scientists and science educators. As early as 1983, major reforms in the education system, including a longer school day and year, were recommended in order to extend education in four basic subjects; English, mathematics, social studies and science (Morton & Dalton, 2007). Reasons cited for increased science time include gaining knowledge of natural surroundings, understanding methods, and discerning between opinion and evidence.

Early education in science and mathematics is important because pre-science and math interests and attitudes are being developed (Blank, 2013; Deady, 1970). Young students who have an interest in science may pursue careers in these fields. Reduced science time could impact this development; however, it makes sense that to learn about science, time needs to be devoted to the subject. Whether the approach to learning science is through inquiry or direct instruction, learning time is necessary (Judson, 2013).

Reports of less time being devoted to science instruction are not difficult to find. Trends in science instruction from 1994 to 2008 show a net decline in science instructional time while there has been an increase in language arts, reading and mathematics (Blank, 2013). Science education has suffered due to the demand on schools to emphasize math and reading since the start of the No Child Left Behind Act of 2001(NCLB). Seventy-one percent of school districts reduced elementary school instructional time in at least one other subject to make more time for reading and mathematics (Rentner et al., 2006). In some case study districts, struggling students receive double periods of reading or math or both, sometimes missing certain subjects altogether. Science and social studies were the subjects that were most often reduced (Griffith & Scharmann, 2008). As reading and math are always included in the Annual Yearly Progress (AYP), many teachers focus on them as they directly affect a school's AYP as set forth in the NCLB (Judson, 2013). Data gathered from regular, full-time public school teachers in self-contained classrooms show that instructional hours are dominated by language arts (Judson, 2013). In fact, on average, about one-third of the student school week was used for language arts followed, in descending order, by mathematics, social studies and science (Morton & Dalton, 2007).

Reduction in science instructional time can also be attributed to a lack of supplies and equipment, and lack of support from administrators. Most elementary school teachers do not enter teaching to teach science (Young, 2007). Teachers avoid science due to lack of familiarity with content area in addition to having negative attitudes towards science. Another factor to be noted is that decisions about elementary school academic content, and the time allotted to subject matter, are often made at the local level

and sometimes by the individual teacher (Blank, 2013). For example, a teacher with an affinity for science may decide to incorporate various science topics or activities into the curriculum and ensure time is dedicated to learning the topics. Similarly, a teacher who does not have an interest in science may decide to forego the subject of science altogether.

There are advocates who want science to be included in a school's AYP as this accountability would prompt allocating additional instructional time towards the subject (Froschauer, 2006). The Report of the 2012 National Survey of Science and Mathematics Education details many trends in science and mathematics including teachers' background and beliefs and professional instruction. Of particular interest is the time spent in elementary science classes: grades K-3 self-contained classes spent an average of 89 minutes per day on reading and 54 minutes on mathematics instruction, compared to 19 minutes on science and 16 minutes on social studies (Banilower et al., 2013).

Block scheduling and its effect on science achievement has been examined, albeit at the high school level. Veal (1999) explored the differences in instructional methods, efficacy of teaching and student achievement between a traditional science class and a block scheduled class. Teacher, parent and student surveys completed both before and after the course evaluated instructional methods, grades, and subject preference. Assessments in the form of multiple-choice questions were constructed for ease of evaluation, as there were no pre-existing tests. The author also implied that some students learn science better in an environment with longer periods.

Hill (2007) describes a Mathematics/Science Housing (MSH) study which was aimed at improving mathematics achievement. Students in a large urban school district in Texas were randomly assigned to either a traditional class or the MSH class. The traditional students attended a 90-minute mathematics class and an additional 45-minute class for science and social studies rotating every other day for each subject. The 45-minute classes were taught by either the science or social studies teacher. The MSH students learned the combined math and science curriculum in a 135-minute block class taught by a science teacher. The combining of the subjects increased the opportunities for students to experience real life applications. The author reported that the integration of science brought order and relevance to the perceived abstractness of the mathematics. Students learned the math behind the periodic table of elements, studied force and motion, measured and graphed temperature and calculated the volume of garbage (Hill, 2007).

Connections between science and math seem natural as we make observations from results of experiments and use math to collect, organize and analyze the data into tables and graphs (Duschl, Shouse, & Schweingruber, 2007). Math helps us see patterns while science probes the concrete example of abstract mathematical ideas. Both subjects represent data using pictures, tables, graphs and equations (Park Rogers, Volkmann, & Abell, 2007).

In the Report of the 2012 National Survey of Science and Mathematics Education, Banilower et al. (2013) explains that opportunities to learn math and science are affected by factors including time spent on subject instruction; and that science is being taught less frequently than math. In contrast, schools offer fewer programs outside

classroom instructional time to encourage student interest in math. On the other hand, science clubs are commonly found and the frequency of such clubs increase with age and grade. As stated by Hill (2007, p. 63), “Mathematics is the language of science and science enriches real-world mathematics problem solving. Or in mathematical terms, mathematics + science = success for all.”

METHODOLOGY

The realization that science and math are closely related and that many skills and concepts are common to both and that teaching them in an interrelated fashion could show increases in student interest, understanding, motivation, and confidence, thus preparing students for future STEM careers formed the basis for this investigation. This action research-based project involved incorporating additional science instructional time into the weekly curriculum of a second grade class. Science concepts were taught in context with the Archdiocese of Washington (ADW) Science Curriculum Standards for second grade. An exemption for the research methodology utilized for this project was received from Montana State University’s Institutional Review Board and compliance for working with human subjects was maintained. The project was conducted over a 12-week period, from January 2016 through May 2016.

The second grade at Blessed Sacrament School consisted of two classes, 2A and 2B. Each class consisted of 20 students, evenly split between girls and boys. Several of the students in each class were in reading resource. Resource, at the school, was defined as supplemental help in place for students to work towards grade level mastery in reading or math. Every September, Blessed Sacrament students took the computer-based

Scantron language arts and math assessment, which provided a starting point to assess a student's subject matter knowledge.

Scantron measured a student's ability level in a subject. The math scores were broken down into subcategories including numbers and operations, algebra, geometry, measurement, and data analysis and probability. These individual scores were averaged into a scaled score. The scaled score was defined by Scantron as a student's ability level in a subject area-instructional level independent of grade. The scaled math scores listed for second grade performance levels were: below average (less than and including 1892), low/high average (1893 to 2106), and above average (2107 and above). The estimated percent correct for all test questions aligned to grade and topic, national, ADW and school average percentile rankings were graphically represented for each student.

For second grade students, Scantron was the first standardized test in their academic life. Starting at the beginning of the school year, both second grade classes received a typical 45 minutes of weekly science instructional time covering the ADW standards. Scantron tests were administered to the second grade students for a second time in January.

To implement the action research-based project, the January Scantron results were analyzed for mathematics and the treatment was implemented. Class 2B was given the additional science instructional time. As the 2B homeroom teacher was flexible with time and availability, 2B received a 100% increase in science instructional time per week. The additional instructional time allowed supplemental lessons to be taught that were mathematically enriched. Concepts such as graphing, temperature, time and patterns

were foundational science skills that were often given short shrift because of time restrictions.

All of the students at Blessed Sacrament took Scantron testing for a final time in May. Using the Wilcoxon Signed Rank Test, the 2B Scantron math scores for January 2016 were compared to those of May 2016 to analyze how increased science instructional time affected students' understanding of math content for that time period. Additionally, using the Wilcoxon Rank Sum Test, the treatment class, 2B, Scantron math scores for May 2016 were compared to the 2A Scantron math scores for May 2016 to further analyze the effect increased science instructional time had on math scores.

In January, 2B, which was to receive the treatment, took a science survey in order to evaluate student interest in science (Appendix A). I developed a short and easy to understand questionnaire using a thumbs-up, thumbs-down design. In April, the same second grade class took the science survey again. Results between the two surveys were tallied and the student responses were graphed to help determine if an increase in instructional time had any impact on student interest, motivation and confidence in science. A math survey, using the same design, was distributed simultaneously to likewise evaluate student interest, motivation and confidence in math (Appendix B). As with the responses from the science survey, the student responses were graphed to help determine if an increase in instructional time had any impact on student interest, motivation and confidence in math.

During the intervention, a science assessment was given to both second grade classes. The assessment was teacher-developed and aligned to the textbook and ADW Science Curriculum Standards. The pre-test was administered before the unit, and then a

post-test was given at the end of the unit to assess how an increase in science instructional time affected students' understanding. The format, familiar to the students, consisted of multiple-choice questions, short responses and diagrams. The assessments were graded by the science teacher (Appendices C and D). The results of the assessment from both classes, including the statistical mean, median, mode and range, were compared to each other. In addition, both second grade classes were given formative assessments which included student projects, probes and worksheets (Appendix E) and which were evaluated using the appropriate rubrics (Appendix F) to verify understanding of science content. The results of the unit assessments from 2B and 2A, again including the statistical mean, median, mode and range, were compared to each other.

As the project was conducted over a length of time, I was able to briefly interview every second grade student. The science and math interview prompts were identical except for the subjects themselves (Appendix G). The purpose of the one-on-one discussion was to probe and explore student interest, motivation and confidence in science and math. Responses were analyzed for common themes.

Finally, using prompts such as: *What are the positives/negatives about extra science time?* and *What changes should I make?*, I kept a journal to record and then reflect upon my teaching and the impact that the increased time had on improving student understanding of math and science. My perception of student interest, motivation and confidence was documented and qualitatively evaluated. The data sources described above are summarized in the Triangulation Matrix (Table 1).

Table 1
Triangulation Matrix for Data Collection

Research Questions	Data Source		
	1	2	3
<i>Primary:</i> How will an increase in science instructional time affect students' understanding of math content?	Scantron Math scores taken in January and May for 2A and 2B	Formative Assessments (student projects, probes and worksheets) for 2A and 2B	Teacher Journal
<i>Secondary:</i> How will an increase in science instructional time affect students' understanding of science content?	Formative assessments (student projects, probes and worksheets) for 2A and 2B	Pre-Post Assessments for 2A and 2B	Teacher Journal
<i>Secondary:</i> How will an increase in science instructional time affect student interest, motivation and confidence in science?	Science Survey for 2B	Student Interviews for 2A and 2B	Teacher Journal
<i>Secondary:</i> How will an increase in science instructional time affect student interest, motivation and confidence in math?	Math Survey for 2B	Student Interviews for 2A and 2B	Teacher Journal

DATA AND ANALYSIS

Scantron

The Wilcoxon Signed Rank test was used to evaluate data in order to answer the primary research question: *How will an increase in science instructional time affect students' understanding of math content?* The test calculated the significance of the difference between the 2B Scantron math scores from before and after the treatment (Figure 1). The January 2016 math scores were established prior to the implementation of the supplemental science instructional time. The May 2016 math scores were obtained after the additional science instructional time was implemented. The Wilcoxon Signed Rank nonparametric test established that the medians of these distributions were statistically significantly different ($p=0.0003$). The data revealed improvements in 2B students' math scores between January 2016 and May 2016.

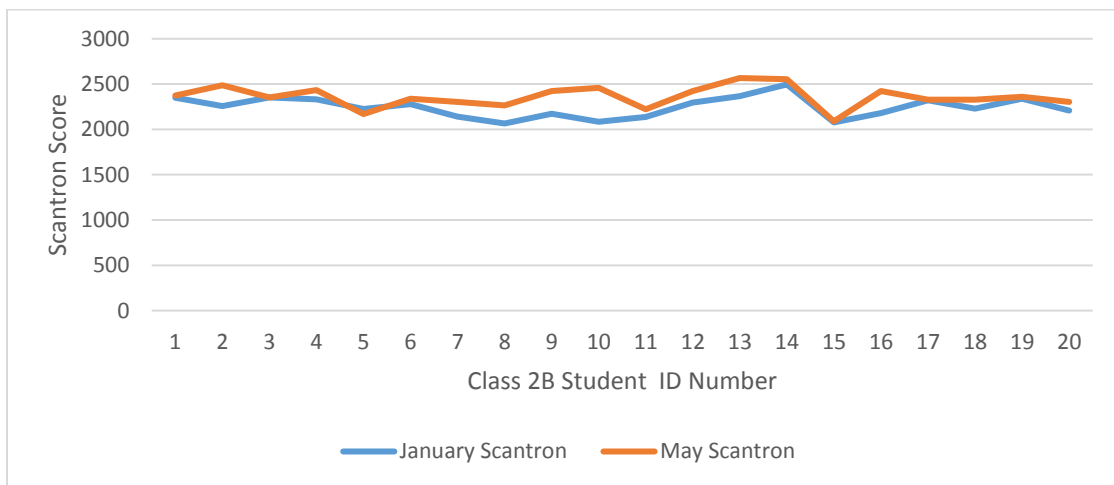


Figure 1. Scantron math scores for Wilcoxon Signed Rank test, ($N=20$).

The Wilcoxon Rank Sum test was also used to determine if the treatment affected students' understanding of math content. The test compared the 2A Scantron math scores for May 2016 and the 2B Scantron math scores for May 2016 (Figure 2). The Wilcoxon

Rank Sum test established that the mean scores of these two distributions were not statistically different ($p=0.1762$). There was insufficient evidence to conclude that the treatment class, 2B, scored significantly higher than 2A on the May 2016 Scantron math test.

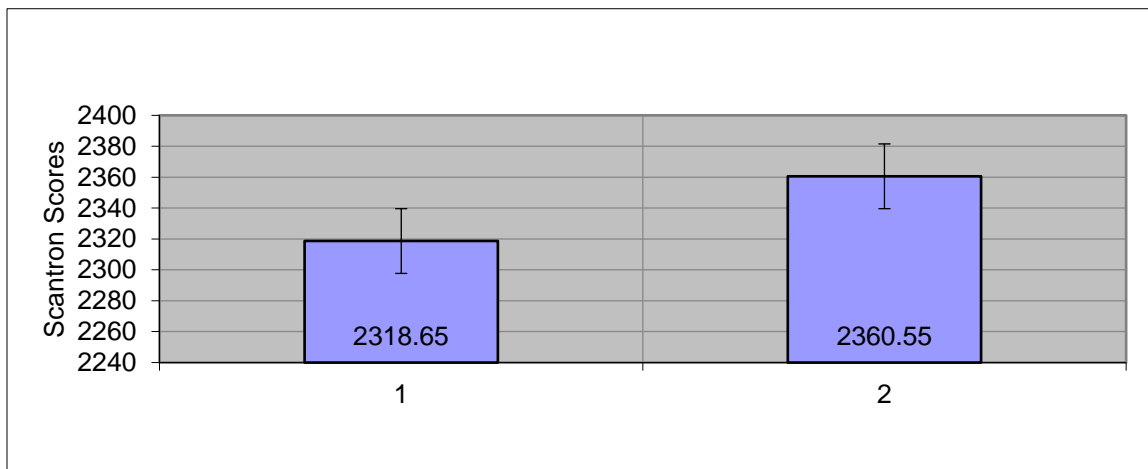


Figure 2. 2A (1) and 2B (2) Scantron math scores for Wilcoxon Rank Sum test, ($N=40$).

Formative Assessments

To determine if an increase in science instructional time affected students' understanding of science content, all of the second grade students were given formative assessments which included a science project and worksheets. The project was distributed with a rubric indicating expectations for the assignment. Criteria such as following instructions, researching information and orally presenting the material were described and the levels of quality ranging from complete to incomplete to missing were explained and weighted. On a scale of 0 to 15, 100% of the students received a perfect score of 15. As it was difficult to assess the depth of knowledge from a project for this young age group, I interpreted this to mean that the students can follow directions.

One of the worksheets that the students were given to complete addressed measuring the volume of a liquid. While successfully answering the question regarding how many mL are in a cup, many of the students faltered on writing a number sentence demonstrating how they arrived at the answer. True, yet incorrect, answers such as “200 is bigger than 100” and “I counted” made scoring the work product difficult. As a result, I excluded the formative assessments information from my findings.

Pre-Post Assessments

After distributing the pre-test, which measured student understanding of states and properties of matter, it became apparent that the process of summative assessment in the second grade was different than at other grade levels. Collaboration between students, almost to the point of producing a group product, was evident. Both second grade classes struggled to complete the pre-test without asking for clarification and encouragement. It became apparent that the students were accustomed to having the classroom teacher review their responses and return them for correction before a final submission. A word bank, including one extra word, was provided for the fill in the blank portion of the pre-test. Regrettably, this caused confusion, as did the fact that all of the words provided were capitalized even though most of the answers were not at the beginning of the sentence, which would require a capital letter. It seemed many students were too focused on punctuation/sentence structure and not content.

Fully one-half of the students circled all of the multiple-choice answers or circled the questions themselves. Several students spent time drawing boxes next to each lettered response. As I observed that these actions were largely limited to 2A, it appeared that their familiarity with multiple-choice questions was confined to those on a

computerized assessment. The pre-test became a preparation for the post-test in form and function not substance, therefore the results from the pre-test were discarded.

Having become familiar with my expectations with the testing process, the administration of the post-test appeared to be more successful. The students used privacy folders, remained in their seats, understood that the answers should be their own, and were able to complete the test during class. The results (Figure 3) show that 2A, which had the normal science instructional time, had a mean score of 62% and a median score of 60%. The range was 50 spanning from 40% to 90%. The first quartile was 40, the third quartile was 70 and the interquartile range was 30. There were no outliers. In comparison, 2B (Figure 3), with the increased science instructional time indicated a mean score of 79% and a median score of 80%. The range was 40 spanning from 60% to 100%. The first quartile was 65, the third quartile was 90 and the interquartile range was 25. There were no outliers. Clearly, the scores were higher for 2B, the treatment group, than 2A, the non-treatment group.

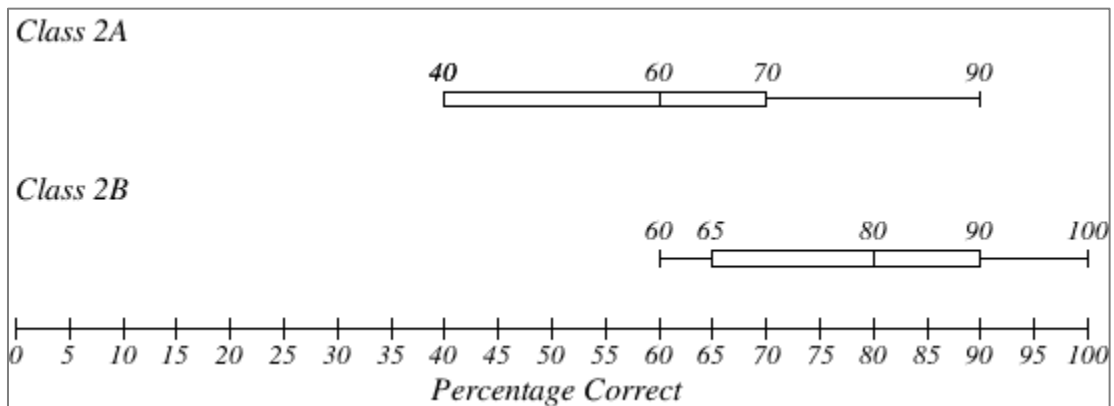


Figure 3. Class 2A (N=19) and Class 2B (N=17) post-test science assessment.

Science and Math Surveys

In January 2016, Class 2B, the students who were to receive the treatment, took science and math surveys to gauge their opinion about the subjects (Appendices A and B). Thumbs-up was used to indicate a positive response, thumbs-sideways was used to indicate a neutral response and thumbs-down was used to indicate a negative response. In April 2016, 2B completed the science and math surveys for a second time to assess if their opinions about the subjects had changed as a result of the additional science instructional time. For ease of graphing, the terminology has been shortened to Positive, Neutral and Negative.

There appeared to be little change in the science survey results for several of the questions as a result of the action research project (Figure 4). In January, of the 20 students responding to Question 1, *How do you feel about science?*, 60% felt positive about science and 40% felt neutral. The extra class time did not have any impact on their feelings when responding to the survey in April. The responses to Question 3, *Do you learn interesting things in science?*, also did not change after the treatment; fully 85% of the class maintained feeling positive about learning interesting things in science. After the treatment, in answering Question 4, *How do you feel about the experiments you do in science?*, one student changed his mind about from being uncertain or negative about how he felt about the experiments in science to showing approval.

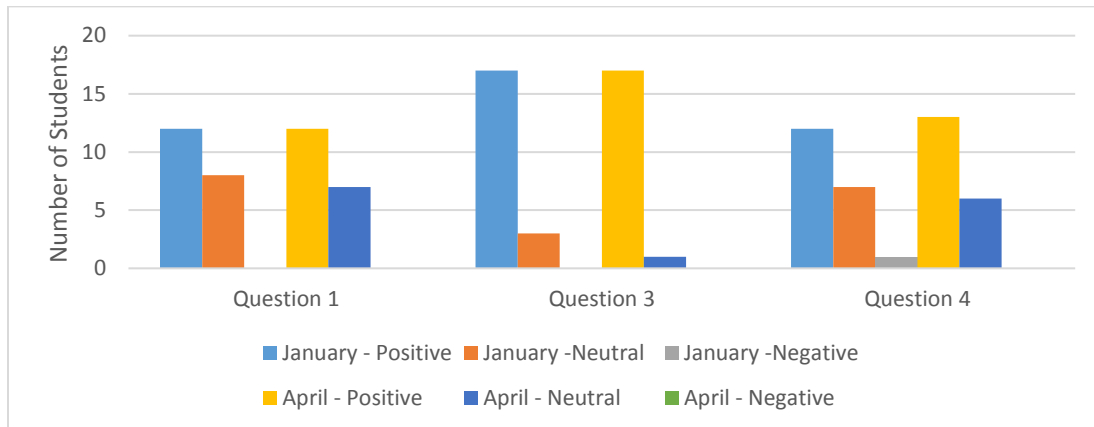


Figure 4. Class 2B Science Survey responses for questions 1 (feelings about science), 3 (learn interesting things in science) and 4 (feelings about experiments), (January, $N=20$) (April, $N=19$).

Two of the most noticeable shifts were seen in the responses to Question 2, *Are you good at science?*, and Question 5, *Do you work hard in science?* (Figure 5). Almost 38% of the students changed their thumbs-up response to being good at science to a thumbs-sideways response. In an interview, one student explained, “I like science but as I learn more, it makes me think that there is a lot more to learn and then I have to remember more, and that is hard.” Another question that indicated a change in response was Question 5, whether a student works hard in science. In April, two students, or 17% of the class, changed from agreeing that they work hard to being unsure.

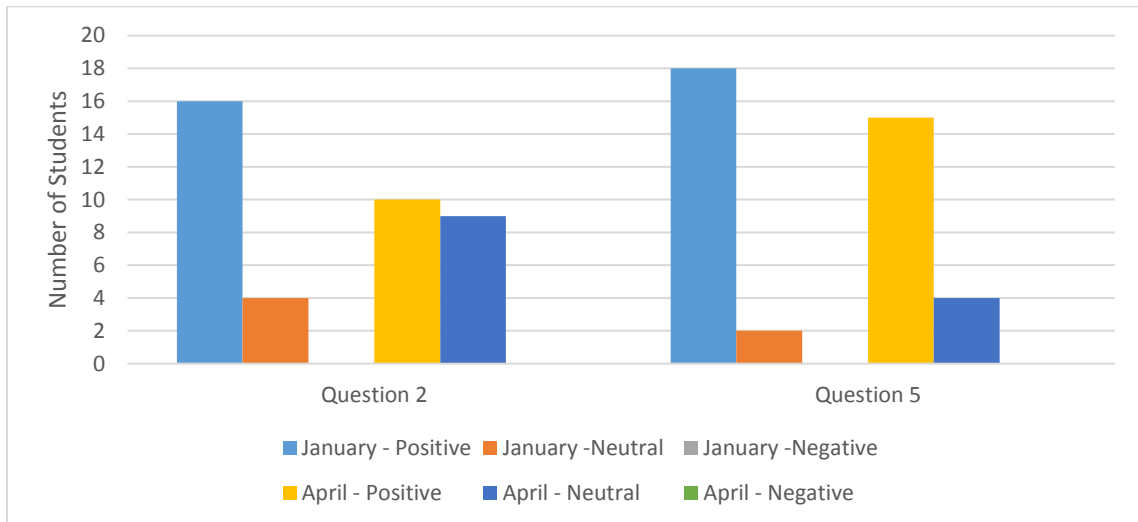


Figure 5. Class 2B Science Survey responses for questions 2 (good at science) and 5 (work hard in science), (January, $N=20$) (April, $N=19$).

January's science survey Question 6, *Do you think science and math are related?*, showed an equal number of thumbs-up and thumbs-sideways choices. After the action research project the thumbs-up selection rose 75%. Similarly, January's math survey Question 6, *Do you think science and math are related?*, shows an equal number of thumbs-up and thumbs-sideways choices. And, again, after the action research project, the thumbs-up selection rose 75%. It should be noted that Question 6 on both the science and math surveys was identical and both surveys elicited identical responses when questioned whether math and science were related (Figure 6).

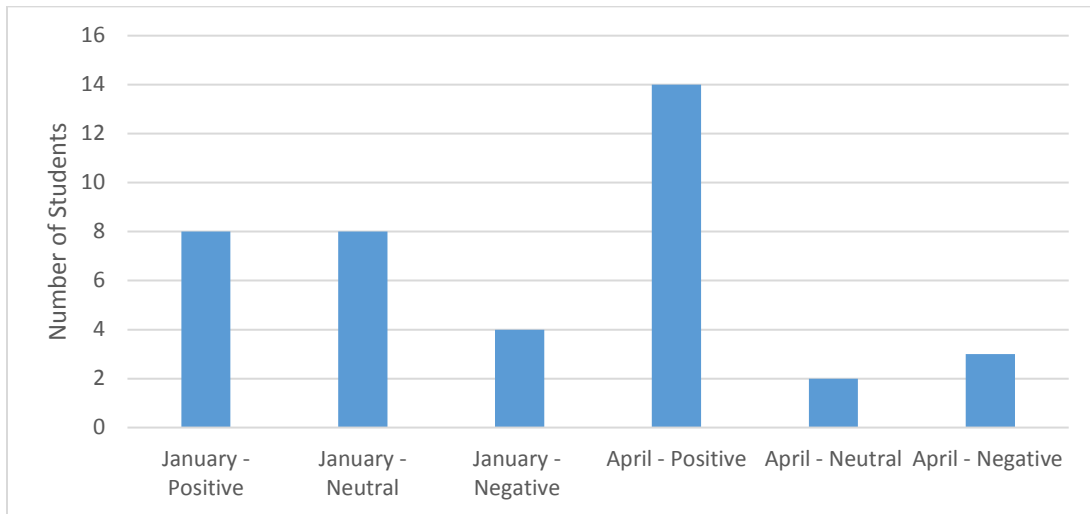


Figure 6. Class 2B Science and Math Survey responses for Question 6 (math and science are related), (January, $N=20$) (April, $N=19$).

As with the science survey results, there was little change in the math survey results for several of the questions (Figure 7). The responses to Question 3, *Do you learn interesting things in math?*, did not change after the treatment; 75% of the class maintained feeling positive about learning interesting things in math. Additionally, in answering Question 5, *Do you work hard in math?*, both in January and April, 95% of the students maintained that they worked hard in math. Question 2, *Are you good at math?*, showed almost 19% of the students changing their thumbs-up response to a thumbs-sideways response.

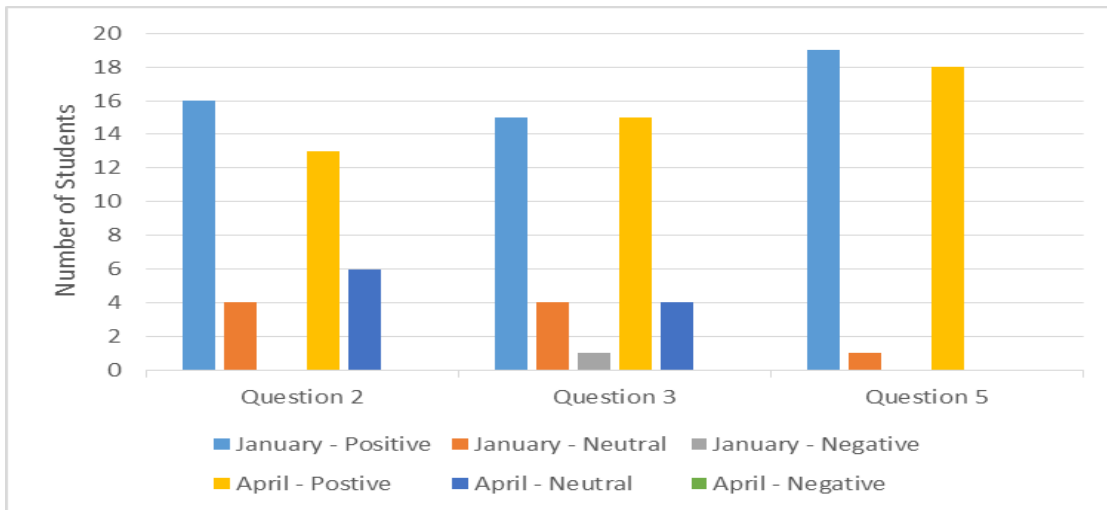


Figure 7. Class 2B Math Survey responses for Questions 2 (good at math), 3 (learn interesting things in math) and 5 (work hard in math), (January, $N=20$) (April, $N=19$).

Two of the biggest changes are seen in the response to Question 1, *How do you feel about math?*, and Question 4, *How do you feel about the activities you do in math?* (Figure 8). The math survey results from January showed 60% of the students felt neutral about math; however, in April this changed to 75% of the students feeling positive about math. Similarly, in April, there was a 60% increase in students feeling positive about the math activities. In interviews, students commented “I like math a tiny bit more because it makes me think math is related to science,” and “Science helped me like math more.”

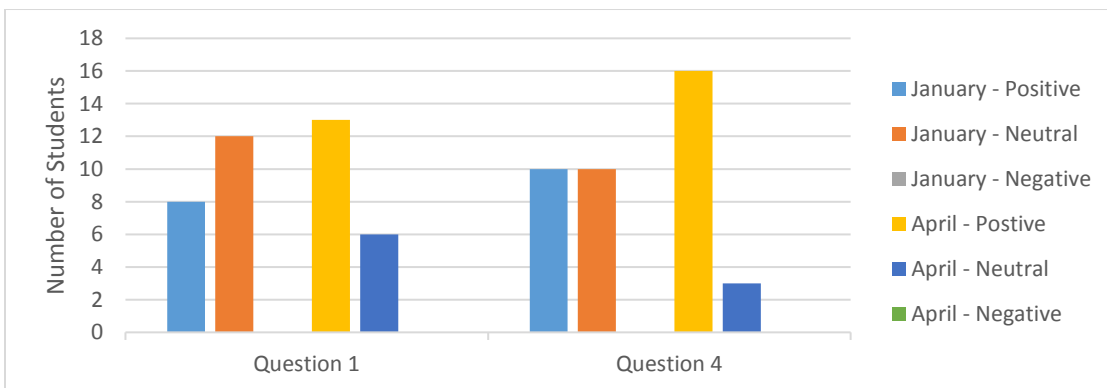


Figure 8. Class 2B Math Survey Responses to Questions 1 (feelings about math) and 4 (feelings about activities) (January, $N=20$) (April, $N=19$).

Student Interviews

Individual interviews were conducted with each second grade student during the months of February and March 2016 to gain insight into student thoughts and opinions about science and math. These one-on-one meetings allowed for thoughtful discussions examining interest, motivation and confidence. Every student was asked to be truthful. I emphasized that a truthful answer would not be hurtful or incorrect. The students were very cooperative. Second grade students have math class every day and about half indicated that this was an acceptable amount of learning time. One student offered “Math is the right amount of time, but I’d like less homework.” The rest of the students were evenly spread out in their desire to having math four days a week to never having math during the week. There were a couple of children who wished they could meet more than once a day, for math instruction, every day of the week. Students, regardless if they thought math was interesting or boring, understood that math helps in adulthood by “counting your change when you buy a home or pay taxes.” There were several comments about liking multiplication and “the opposite of multiplication” (division). Of the 40 children interviewed, 36 were sure that their classroom teacher understood math and 40 were sure that the science teacher understood math. Explanations as to why a science teacher understands math included “Science has math in it!” and “Math and science are alike.”

In contrast, of the 40 children interviewed, only 16 felt that their homeroom teacher understood science. Several students mistook the homeroom teacher planning lessons in the back of class during science instruction as an indication that the teacher

was not learning with the class. All 40 children indicated that the science teacher understood science.

The standard second grade curriculum in the school includes science class one day a week for second grade students. Several major themes regarding science class frequency became evident during student interviews. Ninety-five percent of 2A offered that they would prefer to have science more than one day a week. In fact, 65% indicated they would like to have science five days a week. Class 2B, who had the additional science instructional time, had a surprisingly divided response regarding their extra time. Half of the class was excited to be “chosen” for the extra instructional time and hands-on learning. One student indicated that “it’s special to be part of Mrs. Marshall’s teacher school experiment”. The other half of the class felt that “all of second grade should have science twice a week because lots of people love it and it isn’t fair.”

The process of interviewing the students allowed a more thorough exploration into the common theme of both surveys which indicated that the students felt they were not as good at math and science when comparing the January to April results. Several students explained that the coursework was currently more difficult in both subjects. The students were starting to learn two digit subtraction in math and learning to collect and interpret data in science which are difficult concepts for students to grasp.

Teacher Journal

The treatment allowed for a deep reflection of my educational beliefs. The benefits of extra science time were evident in the students asking more meaningful questions about subject matter. “How?” and “Why?” were more noticeably asked and the

extra time allowed for grade appropriate responses. Their curiosity was admirable, and like their energy, limitless.

INTERPRETATION AND CONCLUSION

It became apparent quite early in the action based research project that a primary challenge was the age of the students. Their proficiency with the general function of being a student was still developing. For example, the introduction of using a rubric to score the formative assessment project ended up serving a more important function than a process for grading; it taught the second grade students to judge the value of their own work. They learned to understand the expectation and strove for the highest quality in their end work product.

Seven year old children are of the age where they view the adult in the room as the sole figure of authority and still genuinely like school. I had not anticipated my impact on the students. It became evident when a student said “I love science and I love my science teacher!” that the students might be unable to separate science as a subject from me being the subject teacher. For 90% of the second grade students, it is the third year that I have taught them. A teacher who was unknown by the students might end up with different results.

The worksheet (Appendix E) was another example of how inexperienced the students were. Question 2 asked for a number sentence to show how the answer is found. The type of responses were varied and spanned from the correct number sentence, to just the correct answer, to true facts, to the incorrect answer and finally to a verbal description. In the end, reviewing the worksheet as a class invited a discussion about math and its role in measurement and in science.

The results of the science and math survey responses in tandem allowed an evaluation of my secondary research questions regarding student interest, motivation and confidence in the subjects. Generally, it seems that there was no significant positive or negative change in student interest or motivation in science or math as a result of the increased science instructional time. One exception is the positive change in the students' feelings about math activities. I believe that this rise is directly related to a science class on linear measurement that used Matchbox cars and track. Perhaps most importantly, it should be noted that the students in 2B were able to make a clear association between the subjects of math and science as a result of additional instructional time.

I was surprised that the extra time seemed to have a negative impact on the students' confidence in both subjects. This data seemed to be in direct contrast to a science notebook journaling prompt inquiring about having science class twice a week. The responses were predominantly positive. However, perhaps the student who indicated "I like science right now, but if I learn more, it makes me think that there is a lot more to learn" provides some insight into the drop in confidence. This drop may really indicate a developing awareness of the scope of scientific knowledge.

A major source of data for my action research-based project was the Scantron math scores for the second grade. As the null hypothesis for the Wilcoxon Signed Rank test was rejected, it appears that there is a relationship between increased science instructional time and math scores for 2B. Furthermore, the increases in Scantron math scores coupled with the higher scores on the post-test assessment seem to indicate that the treatment may have helped to increase 2B students' understanding of science. It should

be noted that there are other factors that should be considered with regard to testing. Students, at the age of seven, are starting to make great strides in their learning. Many mathematical skills such as addition, subtraction, estimation, measurement and time, are starting to be genuinely understood. This learning process alone might have an impact on advances in testing. Computer proficiency, as well as the physical testing environment, may also be factors worth considering.

In many ways the journaling led to more questions than answers. One prompt; *What changes should I make?* became *What changes could I make?* My unique position of being the only science teacher for the lower school, teaching six grades and 18 different classes in 45-minute blocks of time allows for only so much alteration. Ideally, I would rework the science class periods so that the kindergarten through second grade band had smaller blocks of time but with increased frequency. Third grade presently receives 90 minutes of science per week which is certainly an improvement in comparison to the lower grades. Finally, I would rework the fourth and fifth grade classes to include more instructional time and build in a rotating lab class that would be longer than a 45-minute block.

Regardless, as any major change to this type of schedule is unlikely, I could integrate more math, such as measurement and data analysis, into my science lessons. Additionally, I could do more to emphasize the commonalities of both subjects. Interpretation, reasoning, sorting and observation are some of the skills that overlap both topics. Lastly, acknowledging that many teachers will not be able or willing to supplement the language arts curriculum with science material because of time

constraints or subject matter obligations, I could partner with the school librarian and provide the students with a list of science related reading selections.

VALUE

Young students have a natural curiosity about science. Asked to complete the sentence; *Science is ...*, student responses ranged from “the best subject ever,” to “useful,” to “mind blowing.” A vibrant and dynamic subject that captures the attention and imagination of our future generation should be strengthened so that at least part of the dream, as mentioned in one interview, of becoming a “part-time science teacher, spy, chemist and detective” can be realized.

This project has provided me with the opportunity to reflect on my teaching practices and the science program in the school as a whole. Realizing that I shoulder the responsibility for the lower school’s interest in the subject of science strengthens my resolve to build a strong foundation for the students of Blessed Sacrament. I have the unique opportunity to ensure that the subject is vertically aligned by knowing the breadth and depth of each student’s prior knowledge. I believe that with the help of the classroom teachers, I can better implement cross curricular investigations that are age appropriate and have a high level of interest. Additional learning time, coupled with science content that is mathematically enriched can give the students a greater depth of knowledge in a high interest field.

My research suggests that additional science instruction time strengthens the concepts that are common to both science and math. They are both analytical in nature. Critical thinking, comprised of skills such as asking questions, reasoning, and evaluating,

is a necessary ability. The better prepared our students are in math and science the better prepared our students will be in solving real world problems.

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APPENDICES

APPENDIX A
SCIENCE SURVEY

Second Grade Science Survey

Class Number _____

1. How do you feel about science?



2. Are you good at science?



3. Do you learn interesting things in science?



4. How do you feel about the experiments you do in science?



5. Do you work hard in science?



6. Do you think science and math are related?



APPENDIX B
MATH SURVEY

Second Grade Math Survey

Class Number _____

1. How do you feel about math?



2. Are you good at math?



3. Do you learn interesting things in math?



4. How do you feel about the activities you do in math?



5. Do you work hard in math?



6. Do you think math and science are related?



APPENDIX C
SAMPLE PRE-TEST

Matter Pre Test

Name: _____

Student Number: _____

**Write the word that best completes each sentence in the spaces below.
Words may be used only once.**

1. Size and shape are _____ of matter.
2. _____ take the shape of the container they are in.
3. A _____ has a shape all its own.
4. A form of matter that might not be seen is _____.
5. A tool used to measure length is a _____.
6. A tool used to measure mass is a _____.

Balance	Properties	Solid
Ruler	Gas	Liquids
	Matter	

Circle the letter of the best answer for each question.

7. Which of the following is true about solids, liquids AND gases?
 - A. They take the shape of their container.
 - B. People make them.
 - C. They take up space and have mass.

8. What is a property of liquids?
- A. They are smooth.
 - B. They flow.
 - C. They are soft.
9. What tool is used to measure the volume of liquid using milliliters?
- A. A graduated cylinder.
 - B. A thermometer.
 - C. A measuring tape.
10. What is one way to know if one object has more mass than another?
- A. It looks bigger.
 - B. It is a dark color.
 - C. It is heavier.

APPENDIX D
SAMPLE POST-TEST

Matter Post Test

Name: _____

Student Number: _____

**Write the word that best completes each sentence in the spaces below.
Words may be used only once.**

1. Matter that keeps its own shape is a _____.
2. Size and shape are _____ of matter.
3. _____ take the shape of the container they are in.
4. A form of matter that might not be seen is a _____.
5. A _____ is a tool used to measure length.
6. A _____ can be used to compare mass between objects.

Balance	Properties	Matter
Ruler	Gas	Solid
	Liquids	

Circle the letter of the best answer for each question.

7. How are liquids different from solids?
 - A. They take the shape of their container.
 - B. People make them.
 - C. They can be measured with a ruler.

8. What is a thermometer?

- A. A tool to measure temperature in Celsius or Fahrenheit.
- B. A flexible ruler.
- C. A straight edged tool that is 3 feet long.

9. Why are properties important?

- A. Because they change matter.
- B. Because they measure matter.
- C. Because they identify matter.

10. What is one way to know if one object has more mass than another?

- A. It looks bigger.
- B. It is a dark color.
- C. It is heavier.

APPENDIX E
SAMPLE WORKSHEET

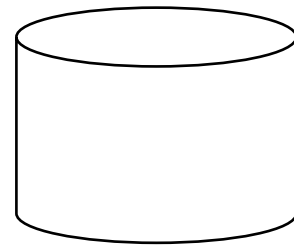
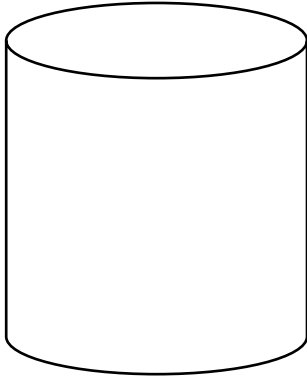
Name: _____ Student Number: _____

WHICH HAS MORE VOLUME?

Tom poured milk into two measuring cups. What can you tell about the two containers of milk?
Which has more volume?

Cup A has 200 mL of milk.

Cup B has 100 mL of milk.



1. How many more mL are in Cup A? _____

2. Write a number sentence to show how you found the answer.

3. Tom added 200 mL of milk to Cup B. Which measuring cup has more milk now?

4. Write a number sentence that shows the total volume of milk for Cup B.

5. Jane poured 400 mL of milk into Cup C. What is the difference between the amount of milk in Cup A and the amount in Cup C?

6. Cup A has 200 mL of milk, Cup B has 300 mL of milk, and Cup C has 400mL of milk.

How much milk do Tom and Jane have altogether?

APPENDIX F
SAMPLE RUBRIC

Student Name/No: GRADE: /15	Complete (2 points)	Incomplete (1 point)	Missing (0 points)
Data is written into science notebook.			
Appropriate measurements are used.			
Labeled sketch is included.			
Cooperation/Lab partner(s) listed.			
Research/Presentation.			
NOTES:			

APPENDIX G
INTERVIEW PROMPTS

MATH INTERVIEW PROMPTS:

1. Is math interesting or boring? Why?
2. You currently study math 5 days a week. How many days a week would you like to study math?
3. Does your teacher understand math?
4. Does your science teacher understand math?
5. Will math help you when you are grown up?

SCIENCE INTERVIEW PROMPTS:

1. Is science interesting or boring? Why?
2. You currently study science one day a week. How many days a week would you like to study science?
3. Does your teacher understand science?
4. Does your science teacher understand science?
5. Will science help you when you are grown up?