# The Effects Of Using An Interactive Student Notebook On The Understanding Of The Concepts And Algorithms Of Addition And Subtraction Of Fractions And Mixed Numbers For Fifth Grade Mathematics Students 

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# THE EFFECTS OF USING AN INTERACTIVE STUDENT NOTEBOOK ON THE UNDERSTANDING OF THE CONCEPTS AND ALGORITHMS OF ADDITION AND SUBTRACTION OF FRACTIONS AND MIXED NUMBERS FOR FIFTH GRADE MATHEMATICS STUDENTS 

by

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B.S. University of Central Florida, 2003

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Education in K-8 Math and Science in the School of Teaching, Learning and Leadership
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#### Abstract

The purpose of this action research study was to observe the effectiveness of the utilization of an instructional tool in my three mathematics classes. Using a tool, called an Interactive Student Notebook, or ISN, the goal was to equip my students with a tool that would allow them to take and keep daily notes as well as conduct guided and independent practice in an organized fashion. I believed that my students would therefore utilize their notes and class work as a reference and study tool to assist them with their homework as well as studying for assessments. Weak to moderate correlations between the students' ISN assessments and end-oftopic assessments scores was found. In-class observations of student utilization of their ISNs and out-of-class observations of students' collected ISNs were also conducted to assess how well students were able to keep their ISNs neat and organized. It was observed that most of the students were able to keep their ISNs complete and organized. Students also shared, by completing surveys, mostly positive feedback of the ISN process. They shared how often they used their ISNs at home as a reference and study tool and how useful they believed their ISNs were. Therefore, I concluded that even though there was not a strong correlation between high ISN assessment scores and high topic assessment scores, the ISN was still a useful tool that assisted my students to keep organized notes and class work, and proved to be a useful reference and study tool.


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# CHAPTER 1: INTRODUCTION 

## Rationale

In the 2009-2010 school year, it was decided that my fifth grade team would departmentalize. With four teachers on the team and the support of our administration, we divided the fifth grade curriculum. Each teacher would focus on mainly one subject: reading, mathematics, science, or social studies. We taught four one-hour blocks, and each student in the fifth grade had four different teachers. I was the fifth grade mathematics teacher. It was my sole responsibility to make sure each student in the fifth grade received all of the mathematics instruction specified in the Florida Sunshine State Standards. As a first year of departmentalization, it was quite successful. Fifth grade state assessment scores rose, and teachers were able to specialize in only one subject, while still collaborating with one another. As the year ended, however, I began to think how I could improve the following year's implementation and instruction. There were also a number of changes that we as a fifth grade team would face and would therefore need to adjust accordingly in the upcoming year.

The first change was the number of teachers on the fifth grade team. With growing student numbers, our team would grow from four teachers to five. Other changes included the scheduling and division of the curriculum. Instead of teaching four sixty-minute blocks, we would now teach three ninety-minute blocks. One teacher would teach three reading periods, one would teach three math periods, a third would teach three science, social studies, and
language arts blocks, while two teachers would split the remaining science, social studies, reading, language arts, and mathematics periods. There would now be a total of five ninetyminute mathematics blocks divided between three teachers, and I would be teaching three of these blocks. I found these changes exciting as it would give me more time with my students, and allow me to try new strategies and activities that would have before been too difficult to accomplish in a one-hour block.

Another change was in Florida's mathematics standards for the fifth grade, as well as for all elementary, middle, and high school grade levels. The Next Generation Sunshine State Standards, or NGSSS, began a partial implementation before the 2010-2011 school year in select grades, but its full implementation would begin during that year. I would be using a new curriculum as well that was written according to these new standards, making a switch from the Everyday Mathematics curriculum to enVision Math (Charles, Caldwell, Cavanagh, Chancellor, Copley, Crown, Fennel, Ramirez, Sammons, Sielack, Tate, Van de Walle, 2011). The NGSS separated the fifth grade standards into three "Big Ideas" and four "Supporting Ideas". The second "Big Idea" of the fifth grade mathematics standards is to develop an understanding of and fluency with addition and subtraction of fractions and decimals (NGSS, 2010). This "Big Idea" would now be the focus for much of the second and some of the third marking periods of the 2010-2011 fifth grade year in mathematics.

I have faced difficulties teaching this subject matter in the past. It has been shown through research that students also have difficulty learning addition and subtraction of fractions and mixed numbers concepts, which will be discussed further in Chapter 2. Because of these
difficulties, and because of the fact that this would be a focus of a good portion of the school year, I wanted a tool I could use in my classroom that would be beneficial for the understanding of these concepts and algorithms, along with the other topics and concepts I would teach throughout the year. I wanted my students to be able to review and reference what we had worked on in class while they worked independently on their homework or while they reviewed for assessments. As is true for many new algorithms in mathematics, there are a number of steps that must be learned in order to successfully add or subtract fractions and mixed numbers. I wanted my students to have adequate practice with these algorithms and concepts in class and the ability to reference the in-class examples, guided practice, and their own independent practice at home.

With all of these upcoming changes, I began to think of the weaknesses of the past year's teaching and implementation of a departmentalized fifth grade team, and started focusing on how I could make improvements on how my students utilized and organized their in-class notes and independent work. The fifth grade team had utilized a three-ring binder system of organization, with dividers for each subject. Some subjects also used spiral notebooks in different ways, such as reading logs and science journals. Algorithms taught in the fifth grade mathematics curriculum, such as the addition and subtraction of fractions and mixed numbers algorithms, require multiple steps. There are also new terms that need to be defined and understood in order for students to properly develop these concepts. In the past, I instructed my students at times throughout the year to take notes on the day's lesson on loose leaf notebook paper and keep them in the mathematics section of their three-ring binders. Most of their class work was done in what was called by the former mathematics curriculum as "math journals." The math journal was a
paperback workbook that was a part of the Everyday Mathematics curriculum. This math journal was more or less the textbook for this series. It was a soft cover book where the day's lessons and examples were included and where students could complete their daily class work.

A few problems arose from this organizational plan. First, many of the notes that were taken in class on loose leaf notebook paper never made it back into the students' binders, or if they did, they were placed out of order, in the wrong section, or sometimes simply stuffed in one of the two outer pockets, never to be used, reviewed, or even seen again. The Everyday Mathematics math journal was not allowed to be taken home, due to the possibility it would be misplaced or lost. Because these math journals served as their in-class textbook and independent workbook, misplacing them would be detrimental. Also, as the school district adopted enVision Math as its sole mathematics curriculum, the math journal that came as part of the Everyday Mathematics series would now be nonexistent anyway and would be replaced by a more traditional textbook format. Therefore, the class work would now need to be done elsewhere, the most probable being on notebook paper.

Because of these changes, I started to wonder how I could avoid the problems that had arisen throughout the previous year while also keeping my students engaged during learning. I wanted my students to take notes that they would not only be able to find at a later time, but that they would find useful to utilize for reference and review. I wanted to help my students attain a sense of ownership and pride in their work and show understanding in their notes and class work. I did not want them simply copying down words and algorithms from the board that had little or no meaning to them, and then solving problem after problem on a piece of paper, without putting
any thought into what they were doing and showing little understanding of the concepts they were learning in class. I wanted them to see their class notes and independent class work as options for later reference and review, so they could look back at their own thought processes at a later time to assist in furthering the understanding of the concepts and material taught in the classroom.

As I was examining other systems and strategies, I found the tool that I believed could help me assist my students in accomplishing these goals. The Social Studies Alive! curriculum written by the Teachers' Curriculum Institute (TCI) developed a tool known as the Interactive Student Notebook (ISN) (Bower \& Lobdell, 2005). With further research, which is included in Chapter 2 of this dissertation, I decided this would be a tool that could help my students be successful and active learners.

## The Interactive Student Notebook (ISN)

The ISN provides a cohesive structure and serves as the organizational anchor for the multiple intelligence activities that occur in a classroom lesson (Bower \& Lobdell, 2005). The authors of the Social Studies Alive! curriculum obviously planned for the ISN to be used with social studies lessons, but as I learned more about the uses and benefits of the ISN and discussed with teachers who had utilized this tool in their social studies classrooms, I wondered if I could use this tool in my mathematics classes and adapt it to be useful for my instruction and my students' learning. I saw the possibilities of using these same organizational and educational
strategies to help my students keep organized notes that could be used for later reference and review while being active learners in the classroom.

Student work in the ISN centers on three key elements: previewing the assignment, graphically organizing notes, and allowing students to process the assignments (Bower \& Lobdell, 2005). These three elements are not just useful for social studies lessons, but are integral to any lesson of any subject at any grade level. A competent teacher first previews and introduces a lesson, using perhaps a short and intriguing problem or assignment to help students connect the new lesson and ideas to their own experiences or prior knowledge. Then as the lesson unfolds, students take notes, either physically or mentally, organizing them as main ideas and details. Finally, the lesson ends as students process the assignment through independent class work to synthesize and apply what they have learned (Bower \& Lobdell, 2005).

Because this is the format of just about any lesson done in my classroom, no matter the topic or subject, I began to see how I could integrate the ISN of the Social Studies Alive! curriculum into a mathematics classroom. The ISN has been shown to help engage students in their learning. Students have been known to embrace their ISN and teachers have reported that because the ISN encourages a variety of forms of expression, there is more involvement, interest, learning and better retention. The ISN is shown to engage students because the students become active participants in their learning. Students are encouraged to use a variety of intelligences, they organize systematically as they learn, and the notebooks become a portfolio of individual learning (Bower \& Lobdell, 2005).

## Research Questions

Therefore, the goal of this study is to answer the following question:

How does the use of the ISN approach affect fifth-grade students' mathematical understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers?

Other sub-questions followed:

1. Will my students effectively keep their ISN organized?
2. Will my students therefore utilize their notes as a reference tool for independent homework and assessment review?
3. Will the class work and writing in the student output portion of the ISN allow students to represent their understanding of the addition and subtraction of fractions and mixed numbers concepts and algorithms being taught in class?
4. Will the aforementioned aspects of the ISN lead to understanding of these concepts when they are assessed?

## Conclusion

I used the ISN to allow my students to be active learners while taking ownership of their learning and therefore utilizing their ISN as a useful and important educational tool. The ISN was originally created by the TCI Social Studies Alive! curriculum, but I learned from coworkers
and through my own research that it had the potential to be used in other subjects, including mathematics. I wanted to take what had been done in social studies classrooms around the country and adapt and utilize it in my own mathematics classroom. I planned to use the three basic elements of a Social Studies Alive! lesson outlined by TCI and using the ISN: preview the assignment, graphically organize notes, and allow students to process the assignments. I knew these same lesson elements could be used in a mathematics setting as well. I saw the possibilities of the ISN and realized how much it could assist my students in taking notes that would not just stay in their backpacks or be thrust into their cubbies never to be used again. But I saw a tool that students could easily reference if they needed to do so. And while I was teaching my students mathematics, I also wanted my students to learn how to become better students. The ISN was a tool that had the potential to help my students become better students, not just better mathematics students. I also planned to observe their learning and understanding first hand when I collected their ISN and saw their class work and written explanations. This would hopefully be a tool that my students and I could both use to be active learners and teachers during the entire school year.

Chapter 2 includes the research behind the most important aspects of the ISN. And while little research could be found about the ISN itself, there are numerous research studies that demonstrate the aspects that were utilized with the ISN in my particular classroom. Chapter 3 explains the methodology used in this action research, including its design, setting and participants, procedures, data collection, and data analysis. Chapter 4 includes the results of my findings, including both the qualitative and quantitative data that was collected. It also includes the analysis of the data. Chapter 5 concludes my research, including the successes and weakness
of the study along with possible improvements that could be made for future utilization of the ISN in a mathematics classroom.

# CHAPTER 2: LITERATURE REVIEW 

Introduction

The ISN is a tool that has a number of purposes. During this literature review, included research will covey the importance of these purposes and reveal how they can assist with student learning and achievement.

First, research will be included that describes students' interest and engagement in the mathematics classroom and some of the difficulties students must overcome when learning fractions concepts. The ISN is a tool that has the innate ability to help teachers' instruction towards multiple intelligences of the students in their classrooms; therefore research about multiple intelligences has also been included. Another aspect of the ISN is its ability to help keep students organized, including their classroom notes. Therefore, research that describes the importance of student organization for classroom success and that which conveys the importance of note-taking as an important skill for students is included. The ISN also allows students a chance to include output of their own thoughts and opinions, so research that describes the importance of writing in mathematics is also prevalent.

## $\underline{\text { Student Interest in Mathematics and Difficulties with Fractions Concepts }}$

As stated by the National Council of Teachers of Mathematics (NCTM, 2000), most students enter third grade with an interest in and enthusiasm for learning mathematics. Students
begin their intermediate grade education believing the lessons they are learning are practical and the concepts they are learning are important. If these students continue to receive proper mathematics instruction that peaks their interest, their teachers will be able to keep them engaged and enthusiastic about learning mathematics, but if the learning becomes merely a process of mimicking and memorizing, however, they will soon lose interest in studying and learning mathematics (NCTM, 2000).

Hidi's (1990) review of interest research stated that student interest in their education has a profound effect on cognitive functioning and the facilitation of learning. This is why it is so important to keep instruction at these intermediate grade levels active and intellectually stimulating in order to help students make sense out of mathematics (NCTM, 2000). Mitchell and Gilson (1997) went even farther, concluding that a well-designed mathematics course may have an effect on students' future academic decisions, stating that if students' interest is peaked early, this early motivation may assist students to continue their mathematics education later in life, perhaps even enrolling or majoring in mathematics fields during their college careers.

If teachers were assisted by utilizing a tool in their classrooms that could help students stay engaged and interested in mathematics, perhaps this would not be such a struggle. Krapp, Hidi, and Renninger (1992) define what is called situational interest. This is an interest that "is generated primarily by certain conditions and/or concrete objects in the environment" (p. 8). Therefore, if a student finds an activity in the classroom interesting, this is situational interest (Mitchell \& Gilson, 1997). The ISN is a tool that would help to create such situational interest. Many students have become accustomed to filling out worksheets or copying down teacher-
written notes from the board, but the ISN changes that. They are instead asked to use the information they record in their ISN to think and apply what they have learned, and therefore, they become more creative and independent thinkers (Bower \& Lobdell, 2005). Mitchell and Gilson (1997) concluded in their study dealing with student interest and anxiety in mathematics that those classrooms that included high situational interest even decreased mathematics anxiety. As is my experience teaching fifth grade mathematics, and as researchers agree, students often struggle with fractions, especially the addition and subtraction of fractions and mixed numbers. When students struggle with concepts, they may tend to lose interest in them, making it more difficult to teach as well.

Charalambous, Delaney, Hsu, and Mesa (2010) stated that student difficulties with fractions have concerned educators since the 1930s and that several cognitive factors might explain errors students often make. Cramer and Wyberg (2009) agreed that teaching fractions continues to be a major challenge faced by elementary and middle school teachers. They continue by stating that one of the main problems is that students will often think of a fraction as two numbers instead of as one, and that it is this inability to internalize that a fraction represents a single number that can lead to misunderstandings when adding and subtracting fractions. Common mistakes students make when adding and subtracting fractions include adding and subtracting both the numerators and denominators and finding a common denominator correctly but failing to change the numerator (Cramer \& Wyberg, 2009). The difficulties of teaching and learning fraction concepts do not just affect elementary teachers and students. Lack of proficiency with these concepts has been shown in high school students up to seventeen years old (Brown \& Quinn, 2006).

Along with student interest, the Interactive Student Notebook serves other main purposes. As TCI states, the ISN provides a cohesive structure and serves as the organizational anchor for the multiple intelligence activities that occur in a classroom lesson (Bower \& Lobdell, 2005). The following section will share research that shows the importance of multiple intelligences in education.

## Multiple Intelligences

As previously mentioned, TCI, the author and distributer of the Social Studies Alive! curriculum utilizes an ISN to accompany and enhance the learning of its lessons. TCI activities are partly based on Howard Gardner's theory of Multiple Intelligences. Gardner (1993) theorizes that people are all intelligent, but in different ways. Gardner (1983) also states that everyone possesses each of the multiple intelligences, but these intelligences are present and developed at different degrees. His theory first defined seven intelligences: logicalmathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal (Gardner, 1993). He later added an eighth intelligence he called naturalistic intelligence (Denig, 2004), and he then added a ninth intelligence known as existential intelligence (Gardner, 1999).

Nelson (1999) summarized the eight of the nine intelligences. Linguistic intelligence refers to the potential to use language, and logical-mathematical intelligence is the potential for understanding cause and effect for manipulating numbers, quantities, and operations. Spatial intelligence refers to the potential for representing the spatial world internally, and kinesthetic intelligence refers to using one's own body or body parts. Musical intelligence is the potential
for thinking in music. Interpersonal intelligence is the potential for working with others, while intrapersonal intelligence is the understanding of one's own self. Naturalistic intelligence is the potential for discriminating among plants, animals, rocks, and the world around us. Lastly, Gardner (1999) explained that existential intelligence refers to the appreciation of spirituality and understanding questions about life, relating to exploring human existence in the universe. Unsatisfied with the claims of traditional "uniform" assessments for intelligence, such as the IQ or SAT, Gardner (1993) wished to present an alternative vision of intelligence, one that was a pluralistic view of the mind, which recognized many different facets of human cognition.

Denig (2004) proposed a synthesis of multiple intelligences with learning styles and believed that people who are strong in a specific intelligence will learn best through methods associated with that intelligence. For example, linguistic intellects would learn best through reading and hearing words and sharing ideas by speaking, writing, discussing, and debating them, while logical-mathematical intellects would learn best by working with patterns and relationships, classifying, and categorizing. Those who are strong in spatial intelligence would learn best by working with pictures and colors, visualizing, and drawing. Those who possess bodily-kinesthetic intelligence would learn best by processing knowledge through bodily sensations. Musical intellects would learn best with rhythm, melody, and song. Interpersonal intellects would learn best through sharing and cooperating with others, while intrapersonal intellects would learn best through working along, reflecting, and doing self-paced projects. Lastly, those who possess naturalistic intelligence would learn best when working in nature, exploring and learning about living things and natural events (Denig, 2004).

According to Goodnough (2001), teachers must develop a professional knowledge of the multiple intelligence theory. This was concluded from results of a case study done with a fifth grade teacher. The teacher used an instructional organizer to critically examine her teaching beliefs and practices. She was able to enhance various aspects of her professional knowledge, including the pedagogical content knowledge, and was able to become more adept at integrating all of the aspects of her professional knowledge of the multiple intelligence theory in her teaching. The researcher concluded that the multiple intelligence theory is much more than merely a theory, but it encourages educators to broaden their view of student ability. Therefore, they are able to guide their teaching and decide what will best fit their students' abilities.

Cheung (2006) describes how multiple intelligences are used in education in China to help drive an ability-driven curriculum. Cheung (2006) describes the importance of educating preprimary teachers to teach for multiple intelligences, explaining how important it is that teachers make a shift from their traditional teaching methods to a modern multiple intelligencesinspired pedagogy.

Other studies have shown the degree of effectiveness of utilizing multiple intelligences in the classroom. McKethan, Rabinowitz, and Kernodle (2010) investigated the use of multiple intelligences in both virtual and traditional skill learning environments. The researchers concluded that students who were stronger in the verbal/linguistic, bodily/kinesthetic, and musical intelligences were better suited for a virtual learning environment. It can be inferred from this study that students with different degrees of intelligences may show different degrees of success in certain situations or environments utilizing different teaching strategies.

Studies by McMahon, Rose, and Parks (2004) and Mokhtar, Majid, and Foo (2008) both described the effectiveness of multiple intelligences in reading and literacy. McMahon, Rose and Parks (2004) administered 288 fourth grade students the Teele Inventory of Multiple Intelligences (TIMI), a tool to pinpoint a person's multiple intelligence strengths. Surprisingly, there was little evidence of relationships between multiple intelligence preferences and reading achievement. In fact, students who showed higher preferences for logical-mathematical intelligence actually demonstrated higher scores in reading comprehension. This study, however, does not discuss how these students were taught, only how they were tested. Therefore, it cannot be used to discount the theories of multiple intelligences. It just shows that students may not mirror their intelligence strengths when assessed.

Mokhtar, Majid, and Foo (2008) describe using multiple intelligences to teaching literacy at a high school level. During the study, students were first trained in information literacy. Some students were then placed in groups that focused on using their dominant intelligence to perform a specific task. It was found that students who were placed into groups based on their dominant intelligence performed better than those that were not. This study, unlike that done by McMahon, Rose, and Parks (2004), focused more on how students were instructed, rather than simply how they perform when assessed based on their predetermined intelligence strengths.

This research helps to demonstrate how allowing students to utilize more than one intelligence may be beneficial. Students who are stronger in one intelligence than another may perform better if allowed to exercise their preferred intelligence. The daily utilization of a tool such as the mathematics ISN would allow students to use a number of intelligences in and
outside of the mathematics classroom. It has been concluded after this study was completed that the different aspects of the ISN would allow students the opportunity to utilize intelligences, including the linguistic, logical-mathematical, spatial, interpersonal, and intrapersonal intelligences.

Another of the purposes of the ISN is to assist students in organization. This is a skill that is important for all students to practice and attain. The next section includes research that shows the importance of student organization.

## Student Organization

Ito (2005) states that a student's ability to stay organized in the classroom is extremely important and these organizational skills are needed for school success. Students who are not able to stay organized may suffer from poor grades, stress, and low self-esteem, and these ill effects are due to lost assignments, wasted energy, and general disorder in their lives (Williamson, 1997). In other words, if students are not organized, they may find it more difficult to be successful in school.

These organizational setbacks affect students with certain learning disabilities, such as attention-deficit/hyperactivity disorder, at an even more severe level. Such students may have significant impairment in organization, which may contribute to observed difficulties in academic achievement (Langberg \& Epstein, 2008). An organizational tool that can help all
students become organized, such as the ISN, could therefore assist students to be better and more successful learners.

Langberg and Epstein (2008) demonstrated how an organizational skills intervention program assisted students with attention-deficit/hyperactivity disorder (ADHD). Thirty-seven students between grades four to seven and ranging from ages nine to fourteen were randomly selected from students who met the criteria for a research screening diagnosis of ADHD. Students in the intervention group were given organization and homework management interventions as part of a two-day-per-week after-school program for eight weeks. Receiving one hour and fifteen minutes of intervention each day, the intervention group showed significant improvement in parent ratings of their academic functioning as well as an improvement in class grades.

It is also important to begin training students how to be organized at an early age. Gambill, Moss, and Vescogni (2008) conclude that early intervention is important for an organizational program to be successful. The study included students from elementary through high school, and they state that students at an elementary level demonstrated a higher degree of interest and were more enthusiastic about learning an educational and life skill. Elementary students were trained to utilize a binder and assignment notebook system, allowing them to become more organized. Because of their enthusiasm, the likelihood that students would retain such skills was greater. The researchers continue by stating that students who are trained to be organized while they are in the elementary grades will follow through with these skills as they progress through grade levels.

Teaching in a departmentalized fifth grade class as I do has forced me to face challenges in trying to keep my students organized. When my students leave fifth grade, they will enter middle school, which has been described as an educational milestone, marking significant and sometimes unspoken changes in expectations (Boller, 2008). A goal of my fifth grade team was to help our students make a smooth transition to middle school. One way was by introducing some organizational strategies and tools to our students. With such organizational tools and skills, students are able to manage their time and materials productively, while taking charge of their own learning (Anderson, Munk, Young, Conley, \& Caldarella, 2008).

Boller (2008) constructs a metaphor of traveling down a road to help describe the hardships that students face when it comes to organization. He refers to these organizational hardships as reaching certain "curves in the road" for which students are not properly trained. As fifth grade teachers preparing students for middle school, it was important that students were trained properly and effectively. Boller (2008) continues by stating that these "curves" can materialize in the form of certain assumptions made by teachers. These assumptions may include that the students are old enough and mature enough to handle certain tasks, including the task of staying organized. It is true that I as a fifth grade teacher have made similar assumptions. I have assumed that my students are "old enough" to copy down their assignments and finish them without being reminded. I have assumed they are mature enough to remember to bring the proper materials to class in order to be prepared on a daily basis, and they should be able to put their class notes and handouts in the proper place in their notebooks without being told every time.

These are assumptions that should not have been made, and organization is another key aspect of the ISN. The ISN uses a variety of organization techniques that can help students keep assignments together in a logical order (Bower \& Lobdell, 2005). Parts of the ISN, including a running table of contents and page numbers, help students stay organized and ensure that their assignments are being recorded and properly organized (Bower \& Lobdell, 2005). These organizational tools and strategies would hopefully prove to be helpful tools in the mathematics classroom.

If students are able to stay organized, they will be able to utilize their tools effectively and efficiently. The ISN not only assists students to stay organized, it gives them a place to store and easily access their classroom notes. These notes are purposeful and helpful because they can be accessed and utilized for further practice and review

## Note-Taking

Taking notes is a popular learning technology in school settings (Kobayashi, 2006), and they are a helpful skill and tool for everyone, not just students. Whether we are writing down a grocery list or sticking a "Post-It" note on the computer monitor, many people rely on some form of notes to help them remember important facts and ideas (Boylf, 2001). Paper and pencil are easily accessible and cost-effective. Even with the popularity of personal computers and newer technologies in classrooms, taking notes with pencil and paper has not been replaced. Haas (1999) concluded that electronic learning technologies will not replace paper and pencil note-
taking, but a mixed use will continue. And as the years have passed, this has stayed true in many of today's public school classrooms.

Class notes serve two very important functions. First, they help student understanding of lecture information and they serve as reference material for later study (Boylf, 2001). Secondly, notes are used as external storage. In other words, they are recorded and stored in order to be referred to at a later date (Faber, Morris, \& Lieberman, 2000). But what is the best way for students to take notes so that they are an effective tool?

Many studies have shown that a traditional style of note-taking, where students are simply copying from the board, is not the most successful. Annis (2001) indicates that the kinds of notes students use in the classroom have a significant effect on achievement. Studies have also highlighted the importance of encoding during note-taking. Encoding means that students are converting the information given into forms that are more easily understandable, or in "their own words." Faber, Morris, and Lieberman (2000) found that note-taking enhances the encoding process of ninth grade students.

Annis (2001) observed that the encoding function of note-taking is most important with college students and that higher essay scores were associated with encoding material so it was personally meaningful to the student. The study included one hundred college students who were given a questionnaire that was designed to assess what kind of notes they preferred: personal, partial, or full lecture notes. At the start of a lecture, students were then given a packet of notes that matched their preference. Students who preferred personal notes received four blank pages of paper on which to take their own notes. Students who preferred partial notes
were given a four-page list of headings and key notes with an amount of space to take their own personal notes, and students whose preference was full lecture notes received a packet of typewritten notes written by the lecturer and asked to take no personal notes of their own. It was concluded that students who used full notes did not score as well as students who utilized partial notes or their own notes. Because full or partial notes required encoding, it was concluded that the encoding functions of note-taking is important.

Verbatim note-taking has been shown to even interfere with deeper processing of lesson information, and therefore reduce encoding effects (Bretzing \& Kulhavy, 1979). Style of notetaking may also increase academic performance. Using non-linear techniques, such as the utilization of graphic organizers, can be more beneficial than a more traditional linear notetaking style (Dror, Kemp, \& Makany, 2009).

It is also very important for teachers to not just give their students the opportunity to take notes, but they must supply guidance and organization for students during the note-taking process. Simbo (2001) observed that the highest achievement occurred when students made notes that were based on outlines provided by the teacher, and the lowest achievement occurred when students compiled notes without any outline or organization supplied by the teacher. Annis (2001) similarly concluded that students who preferred to use partial notes, which gave students an outline to be filled in, scored better on multiple-choice exams. In conclusion, when teachers guide the note-taking process, but allow for student encoding to occur, enhanced student learning and test scores occur (Simbo, 2001).

The ISN builds on these concepts of allowing students to be active in the process of notetaking, instead of merely copying notes from the board or overheard. Students become "hooked" from the beginning of a lesson and are encouraged to record their notes for a purpose, identifying the main ideas and supporting details of the lessons, and interpreting the information (Bower \& Lobdell, 2005). The notebooks utilize not just written notes from the board, but use elements such as graphs, charts, illustrations, group discussions, and group project notes (Bower \& Lobdell, 2005). The ISN steers away from traditional note-taking strategies and makes the student more active during the note-taking process. They are thinking while the lesson unfolds, instead of simply copying definitions and examples from the board. Most lessons include guided practice problems, which allow students to be active learners to solve problems, while still being guided by the teacher. Using the ISN format, students are not just copying verbatim notes from the board, but are actively involved while taking notes.

After students take notes in their ISN, they are given an opportunity to show what they have learned by recording their work, thoughts, and thinking processes when they complete their independent work. The ISN gives students the chance to elaborate their thoughts and the steps they took to solve a problem, which can give meaning to what they are doing in class and show me as a teacher how well they truly understand the concepts and material.

## Writing in Mathematics

Writing has been defined as the ability to compose text effectively for different purposes and audiences (Urquhart, 2009). Writing is a useful tool, and it is not only limited to a language
arts classroom, but it can, however, be incorporated into most courses taught at school (Estes, 1989). The NCTM (2000) states that the ability to read, write, listen, think, and communicate about problems will develop and deepen students' understanding of mathematics. Students will learn mathematics more effectively and more deeply when it is directed by reading and writing (Bosse \& Faulconer, 2008). NCTM (2000) states that intermediate students between grades three and five are expected to use communication as a tool for understanding and generating solution strategies. Students are expected to use their increased mathematical vocabulary and improved writing coherency to explain mathematical concepts. They not only are expected to share their thinking, ask questions, and explain and justify their ideas and answers, but they should be encouraged to express and write about their mathematical conjectures, questions, and solutions (NCTM, 2000).

Over four decades ago, Bruner (1968) stated that both writing and mathematics are devices for ordering thoughts. Graham and Perin (2007) identify eleven elements of writing instruction that can help students learn to write well and to use writing as a tool for learning. Steps that may be useful in a mathematics class include teaching students to summarize, engaging students in prewriting activities, using inquiry activities where students will analyze data to develop their own ideas, and using writing as a tool for learning content material. Writing can be a useful tool in the mathematics classroom because it allows students to make sense out of what they have learned. It must, however, be made clear that reading and writing about mathematics is not the same as reading and writing in mathematics (Bosse \& Faulconer, 2008).

Writing can be used in a number of effective ways in the mathematics classroom. It can be used as a way for students to keep ongoing records of what they're doing and learning, to help solve mathematical problems, to explain mathematical ideas, or describe learning processes (Urquhart, 2009). It can be also help students clarify their thinking and express themselves in a precise way (Estes, 1989). If students are given the opportunities, support, and encouragement to write in mathematics classes, they will become active learners, instead of passive ones (Powell \& Lopez, 1989), they will have a more concrete grasp of the concepts, and they will be able to apply what they have learned to different situations (Bosse \& Faulconer, 2008). Students who write about their problem solving processes have been shown to produce correct solutions at a higher rate than students who used a think-aloud strategy (Pugalee, 2004), and it also gives teachers the opportunity to read students' responses and develop a complete picture of what their students do and do not understand (Baxter, Woodward, \& Olson, 2005).

Because learning to write well requires teacher instruction and practice (Urquhart, 2009), it is important for teachers to assist students in acquiring mathematical language to describe objects and relationships and use specialized vocabulary in its appropriate context (NCTM, 2000). The teacher must be convinced of the efficacy of writing in a mathematics class, and believe in its effectiveness in order for this to occur (Davison \& Pearce, 1990). It is also the job of the teacher to provide students with assistance in writing about mathematical concepts, allowing students to use not just words, but also drawings and symbols to explain a particular mathematical concept (NCTM, 2000).

There are a number of forms of writing that can be utilized in the mathematics classroom. One is prewriting activities or writing prompts. These can be a useful tool in a mathematics classroom and have even been described as essential (Davison \& Pearce, 1990). Aspinwall and Aspinwall (2001) state that such open-ended prompts give teachers valuable insight into a students' perception of the material, which can be important for future instruction. Teachers are able to read their students' responses which enable them to experience a richer form of planning. They can review a day's lesson and student responses to help plan for the next lesson and can formulate problems and strategies based on the difficulties that their students revealed in their writing (Baxter, Woodward, \& Olson, 2005).

Another form of writing that can be useful in a mathematics classroom is free-writing. Students are asked to write as quickly as they can for 3 or 4 minutes about the lesson topic (Burton, 1992). This technique encourages students to think freely and create questions about a specific concept or idea (Urquhart, 2009). It can also help students become active participants in the lesson, and can be used at the end of a lesson to assist students and teachers to become aware of what was understood and what may need further instruction (Burton, 1992).

Other forms of writing in mathematics courses can include mathematics biographies and autobiographies and journal writing. The use of biographies allows students to research life stories of famous mathematicians and even the writers of the Simpsons (Urquhart, 2009). Then students can be encouraged to create their own autobiographies and write about their experiences learning mathematics. Journal writing, also known as mathematics blogs, can be used as
vehicles for students to respond to class discussion or make connections between the content and their real lives (Urquhart, 2009).

The ISN is a tool that gives teachers the ability to use all of the strategies, benefits, and forms of writing mentioned if the teacher desires. The ISN reaches out to students, inviting them to be active participants in their learning (Bower \& Lobdell, 2005). It does not just appeal to students with strong linguistic skills. Students can express themselves in many ways and showcase their multiple intelligences, especially in mathematics, and they can do so linguistically with their own words, visually with illustrations, or logistically with tables, charts, or graphs. With teacher guidance and clear expectations, students can express themselves and their learning through their ISNs.

By using the ISN in my mathematics classrooms, this researcher wishes to use all of its facets to improve mathematics understanding and learning. These facets include strengthening student interest in mathematics, giving students a tool that improves organization, assisting students to take useful notes that they can access and review when needed, and allowing students to express themselves through writing in mathematics. In the next section, Methodology, the procedures of how the ISN will be used in the classroom will be further explained, and how the data will be collected and analyzed during this research will be discussed.

# CHAPTER 3: METHODOLOGY 

Introduction

The purpose of this study was to determine how the ISN would affect fifth grade students' understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers. In the past I utilized a variety of tools for my students to keep notes and complete their class work, including spiral notebooks, three-ring binders, curriculum supplied math journals, or simply loose-leaf paper. I was never pleased with the organization and student utilization of the notes we took in class and the class work the students completed. I felt that many times, their notes and work were lost or discarded, and therefore not properly utilized. Collecting their class work was not useful to me or my students, as grading daily practice problems would be quite time-consuming and difficult to do with three mathematics classes. It is also my opinion that this practice would be better utilized by the students as reference or for studying for assessments. I wanted to find a tool that allowed my students to effectively take class notes that they would use for later reference and review. I wanted my students to possess a tool that was easily accessible, so they would be able to stay organized and find the information they needed when they needed it. I also wanted my students to be able to express themselves through writing so they could reflect on what they had learned and show their understanding and thought processes of the concepts they were learning in class.

I found this tool in the ISN, developed and popularized by the Social Studies Alive! curriculum. Social Studies Alive! is a history and geography series written by the Teachers'

Curriculum Institute. I believed that their three-step approach (previewing assignments, organizing notes, and processing the assignments) could apply to any subject, especially mathematics. My hope was to borrow the methods of the Social Studies Alive! curriculum and the approach supplied by the Teachers' Curriculum Institute and utilize the ISN as a tool that would be beneficial for students and succeed in my main goal as a mathematics teacher: that my students were understanding the concepts of mathematics, and that they were applying these concepts to solve problems.

## Design of the Study

This research is defined as action research. Action research is any systematic inquiry conducted by teachers that involves gathering information about the ways in which their particular schools operate, the teachers teach, and the students learn (Gay, Mills, \& Airasian, 2009). The goal of action research is to gain insight by developing reflective practices to create a positive change in the school environment, educational practice, and student outcomes. According to Gay, Mills, and Airasian (2009), my research could be identified more specifically as practical action research, as I was committed to continued professional development and school improvement and I wanted to reflect on my practices systematically. A goal of the study was to learn how to utilize the ISN in my classroom so my students could organize effective class notes and share their thought processes and conceptual learning through class work and reflective writing. In order to do so, I used mixed data collection strategies, which included both qualitative data and quantitative data collection and analysis.

This study examined the following question:

How does the use of the ISN approach affect fifth-grade students' mathematical understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers?

There were also four sub-questions that followed. Table 1 shows each sub-question, the evidence used to support each question, and whether the evidence was classified as quantitative or qualitative data. The examples of evidence will be further explained.

Table 1: Research Sub-Questions, Evidence, and Evidence Classifications

|  | Sub-Question | Evidence | Evidence <br> Classification |
| :--- | :--- | :--- | :--- |
| $\mathbf{1}$ | Will my students effectively keep their ISN <br> organized? | ISN rubric assessment, in- <br> class observations, <br> collected ISN observations | Quantitative and <br> Qualitative |
| $\mathbf{2}$ | Will my students therefore utilize their <br> notes as a reference tool for independent <br> homework and assessment review? | Student Survey | Quantitative and <br> Qualitative |
|  | Will the class work and writing in the <br> student output portion of the ISN allow <br> students to represent their understanding of <br> the addition and subtraction of fractions and <br> mixed numbers concepts and algorithms <br> being taught in class? | In-class observations, <br> collected ISN observations | Qualitative |
| $\mathbf{4}$ | Will the aforementioned aspects of the ISN <br> lead to understanding of these concepts <br> when they are assessed? | Topic assessments | Quantitative |

## Setting and Participants

## School Setting

The setting of my study was an urban school in Central Florida that was given a grade of A for the 2009-2010 school year. At the time the research began, the school consisted of 607 students, $54.9 \%$ boys and $45.1 \%$ girls. The students at the school were $29.3 \%$ Caucasian, $12.9 \%$ Black, 45.5\% Hispanic, 7.9\% Asian American, and 4.4\% Other. The school consisted of 19.4\% Language English Proficiency (LEP) students and 18.6\% Exceptional Student Education (ESE) students.

## Participants

The study consisted of students from three fifth grade leveled mathematics classes that were taught by the researcher out of five total mathematics blocks. The five mathematics blocks were designated by the fifth grade team and administration and named low, low average, average, high average, and high. Students were placed in these performance-based leveled classes by the fifth grade team and administration by their fourth grade scores on the Florida Comprehensive Assessment Test (FCAT) mathematics test along with past and present classroom performance and achievement. The three classes that I taught were those designated as high, high average, and low average. Of these three classes, the high class had twenty-one students, the high average class had twenty students, and the low average class had fifteen students, for a total of fifty-six fifth grade students. Together, these classes were 35.7\% Caucasian, 14.3\% Black, 30.4\% Hispanic, 14.3\% Asian American, and 5.3\% of students of other descents. They also consisted of 21.4\% Language English Proficiency (LEP) students and
17.9\% Exceptional Student Education (ESE) students, which included 3.6\% Specific Learning Disabilities (SLD) students and 14.3\% gifted students.

## Classroom Setting

The classroom itself was organized in a collaborative group style, with five groups of six desks. Three groups were located towards the front of the classroom, while the other two groups were located further back. The teacher table was centered directly in the front of the three groups and the teacher desk was placed to the side of the front of the classroom. The classroom included a smart board and projector system that was hooked to the teacher's personal computer. It also included a sound system with a microphone for both the teacher and students. Audio enhancement speakers were installed throughout the classroom ceiling. Mathematics tools, such as calculators, rulers, compasses, dice, and protractors were organized on shelves towards the side of the classroom, in easy reach and access to all students. There were also a collection of reference materials, including dictionaries and math reference books, located in the same area.

## Procedures

The ISN was introduced on the very first day of class. Students were asked to bring a spiral notebook as part of their school supply list. This spiral notebook would become the ISN. The first step was to set up the ISN. On the first page, students were asked to title their ISN with their first and last name and then follow that with Math Interactive Student Notebook. For example, my notebook would be titled Brian Twar's Math Interactive Student Notebook. Below
that, students wrote the school year 2010-2011, the school name, and the mathematics teacher's name. The back of this page was kept blank, but the front of the second full page was used for the first page of the table of contents. The purpose of the table of contents was to allow the students to keep their notes and work organized. Everything that was placed and recorded in the ISN, including handouts, notes, and class work would be recorded in the table of contents. The front and back of the next three pages would be saved for the table of contents, giving ample room for the students to keep track of everything in their ISN. Students would record the date, title, and page number(s) of all items, class notes, and independent work placed into and recorded in the ISN. After skipping pages that were to be saved for the table of contents, the students numbered the remainder of the pages of their ISN, starting with page 1 and continuing to the last page of the notebook.

Every page after the table of contents would be organized in a very specific way. With a notebook opened to two blank pages, left and right, the left page was for teacher input only. Teacher input included class lecture notes, vocabulary lists, handouts, and assignment descriptions. The right page was designated for student output, which included written reflections and assignment work and answers. Students were instructed not to put teacher input on the right pages or put student output on the left pages. If students ran out of room on one of the pages, they were instructed to get a separate sheet of loose leaf notebook paper and continue their notes or work. At the end of the activity, they would staple the page in sideways, and fold it in half. This way, students could still easily refer to what was on the page by using their table of contents in the ISN and the extra work or notes that had continued onto the piece of loose leaf paper. Because the pages were stapled in sideways and folded in half, none of the loose leaf
paper would hang out, leaving the ISN neat and organized. This again was another effort to assist students to keep everything placed in the ISN in proper order and make it easily accessible.

While the ISN would help keep students organized, a couple problems were bound to arise. The researcher attempted to plan for these problems. The first was the issue of absent students. Students who were out for a day or more, and therefore missed the class notes and assignments, were instructed to borrow the ISN of a classmate and acquire the class notes of the day or days they missed. Students did not have to make up work on the student output side, but were implored to take a look at their classmate's output and make any notes in their ISN that they would find helpful. They were asked to write the date that they were absent so when the ISN was collected, the researcher would know why the class work and/or reflections were missing.

The other problem was students who entered the school or class as the school year progressed. It would be unreasonable to ask these students to make up all the notes they had missed during the time they attended another school, so these students were not expected to do so. They would be asked to purchase a spiral notebook, or if they could not, one would be supplied for them. They would then be paired up with another student in the class who would assist the new student with setting up the ISN, which included creating the title page and table of contents pages and numbering the subsequent pages. The new students would then, with a bit of a learning curve, be ready to utilize their ISN just as the other students in the class had all year.

## Data Collection

The data collected in this study were both quantitative and qualitative. The quantitative data included scores from topic tests of topics seven through nine of the fifth grade enVision Math series (Charles, et al., 2011). These three topics were titled "Adding and Subtracting Fractions with Like Denominators," "Adding and Subtracting Fractions with Unlike Denominators," and "Adding and Subtracting Mixed Numbers." The topic tests given were created by the enVision math curriculum and utilized FCAT style questions to assess student knowledge. The tests ranged from twelve to fourteen questions each and included mostly multiple choice questions, as well as one open-ended gridded response and one short answer written response question. A copy of these tests can be found in Appendix B. These topic tests assessed lessons and concepts supported by Big Idea 2 of the Next Generation Sunshine State Standards: Develop an understanding of and fluency with addition and subtraction of fractions and decimals (FLDOE, 2010). The following standards were covered throughout the three topics:

MA.5.A.2.1 - Represent addition and subtraction of decimals and fractions with like and unlike denominators using models, place value or properties.

MA.5.A.2.2 - Add and subtract fractions and decimals fluently and verify the reasonableness of results, including in problem situations.

MA.5.A.2.3 - Make reasonable estimates of fraction and decimal sums and differences, and use techniques for rounding.

MA.5.A.2.4 - Determine the prime factorization of numbers.
MA.5.A.6.1 - Identify and relate prime and composite numbers, factors and multiples within the context of fractions.

Quantitative data also included the assessment and evaluation of the students' individual ISNs. Using a researcher-created rubric, the students' ISNs were collected at the end of the three topics and graded for organization, completeness, and neatness. The ISN assessment rubric can be found in Appendix C.

Qualitative data included observations of the students' ISNs during and after class. The researcher made notes and observations during class, viewing how students learned to use their ISN and keep their notes and class work organized and up to date. At the end of the three topics being assessed in this study, three reflection questions were given to the students. Students were given adequate time in class to answer these three reflection questions in their ISN. The three reflection questions were:

1. Why must fractions have common denominators in order to be added or subtracted?
2. Describe a real life example when fractions or mixed numbers would be added or subtracted.
3. How are mixed numbers and improper fractions alike? How are they different?

The researcher also collected the students' ISNs to observe and reflect on the quality of student work and writings in their notebooks. The students' ISNs were collected at the end of the three topics for the purpose of this qualitative data collection as well as the previously
mentioned quantitative assessment. At this time, the aforementioned reflection questions were also analyzed. The researcher was able to make observations on how well the students understood some of the concepts that had been taught and assessed during the three topics by how clearly they were able to answer and explain the reflection questions.

Students were also given a survey at the end of the three topics. The purpose of the survey was to acquire student opinions of the ISN process during the three specified topics. These surveys allowed the researcher to collect both quantitative data and qualitative data. A copy of the ISN Student Survey can be found in Appendix D.

## Data Analyses

Data collected were analyzed to help answer the following research question:

How does the use of the ISN approach affect fifth-grade students' mathematical understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers?

A triangulation of data, including both quantitative and qualitative, was used for analysis. Table 1 in the Design of the Study section of this chapter may again be referenced if needed. End-of-topic test scores, ISN rubric assessments, and student surveys were all used in order to analyze the effectiveness the ISN had on students' understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers. Test scores were individually calculated on a one hundred percent grading scale. These scores were then averaged by class,
topic, and as a whole and rounded to the nearest tenth of a percent. This data also assisted in answering question four: Will the aforementioned aspects of the ISN lead to understanding of these concepts when they are assessed?

Triangulation of data also included a self-created rubric, which was used to assess the students' organization of their ISN. The rubric was separated into four sections, each worth three points. The three sections were Table of Contents, Class Notes, Independent Work, and Neatness. The ISN assessment was given a grade out of twelve. The rubric was created by the researcher to better reflect the specifications of the math ISN being used in the classroom, as opposed to rubrics created by the Social Studies Alive! curriculum, which would better assess an ISN being used in a Social Studies classroom. These scores were, like the topic assessments, averaged by class, topic, and as a whole and rounded to the nearest tenth of a percent. The ISN rubric assessment would also answer sub-question one: Will the class work and writing in the student output portion of the ISN allow students to represent their understanding of the addition and subtraction of fractions and mixed numbers concepts and algorithms being taught in class? Correlation between end-of-topic assessment scores and ISN assessment was then calculated. This was not done to establish a cause and effect conclusion between end-of-topic assessments and ISN assessments. It was merely done to see if there may be a connection between the two.

Qualitative data was also collected during the collection of the ISN. Through observations of the class work and the three reflection questions given at the end of the three topics, the researcher was able to qualitatively reflect on the quality of the students' written work in order to show complete understanding of the concepts being taught. This would assist in
answering sub-question three: Will the class work and writing in the student output portion of the ISN allow students to represent their understanding of the addition and subtraction of fractions and mixed numbers concepts and algorithms being taught in class?

In order to complete triangulation of data, student surveys were completed by and collected from each student and then analyzed by the researcher. A copy of the survey, again, can be found in Appendix D. These surveys would answer sub-question two: Will my students therefore utilize their notes as a reference tool for independent homework and assessment review? Questions two through six of the survey allowed students to answer a question based on a scale of answers. These questions asked how often and how useful their ISN was for homework assistance and studying for tests and quizzes as well as how useful they felt the ISN was as an organization tool. The scales ranged from "Never," "I never used it," or "Not useful" to "Often," "Very helpful," or "Extremely useful." The researcher collected this data and analyzed it quantitatively, calculating the number of students who gave each answer. Students were also asked to share their thoughts and feelings in a short response, with questions that asked their definition of the ISN and their likes and dislikes of the ISN. The researcher used colorcoding to qualitatively find themes in their answers and reflect on the main themes that were found. The researcher made connections from the themes that were discovered.

The purpose of the ISN was to act as a tool that would assist with student achievement. By analyzing the quantitative and qualitative data explained, the researcher hoped to get a full understanding of how successful the ISN was in doing so.

In the following chapter, titled Results, an analysis of the collected data will be shared.
This will include the triangulated data from test scores, assessed ISNs via the researcher-created rubric, student surveys, and researcher observations of the students and students' ISNs.

# CHAPTER 4: RESULTS 

Introduction

This study was conducted during the winter of 2010 and 2011. Its purpose was to answer the following question:

How does the use of the ISN approach affect fifth-grade students' mathematical understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers?

During three topics of study of the fifth grade enVision Math series, students utilized an organized spiral notebook called the ISN in which to take notes, complete guided practice problems, and output their own work and thoughts during independent practice. The goal in this research was to see how the use of the ISN in the classroom as well as at home for reference could assist students in their learning and understanding of the addition and subtraction of fractions and mixed numbers concepts that were being taught.

Data were collected both quantitatively and qualitatively. Quantitative data included the three topic tests that were given at the end of each topic as well as an ISN assessment which utilized a researcher-created rubric. Qualitative data first included in-class observations of how students used their ISNs and if it was a useful in-class tool for taking notes and complete guided and independent work. It also included further observations of the ISN when they were collected from the students for assessment. Observations of the student work, student writing, and organization were made. Lastly, qualitative data included surveys that were completed by the
students to obtain their honest opinions of the ISN. Students shared how they defined an ISN, how often and how helpful they believed the ISN was as a reference tool for homework and studying assistance. They also shared their strongest likes and dislikes regarding the ISN.

Along with the main research question, four other questions were included as focal points for evaluation of the ISN process. The four sub-questions were previously represented in Table 1 in Chapter 3 and are shown again below.

Table 2: Research Sub-Questions, Evidence, and Evidence Classifications

|  | Sub-Question | Evidence | Evidence <br> Classification |
| :--- | :--- | :--- | :--- |
| $\mathbf{1}$ | Will my students effectively keep their ISN <br> organized? | ISN rubric assessment, in- <br> class observations, <br> collected ISN observations | Quantitative and <br> Qualitative |
| $\mathbf{2}$ | Will my students therefore utilize their <br> notes as a reference tool for independent <br> homework and assessment review? | Student Survey | Quantitative and <br> Qualitative |
|  | Will the class work and writing in the <br> student output portion of the ISN allow <br> students to represent their understanding of <br> the addition and subtraction of fractions and <br> mixed numbers concepts and algorithms <br> being taught in class? | In-class observations, <br> collected ISN observations | Qualitative |
| $\mathbf{4}$ | Will the aforementioned aspects of the ISN <br> lead to understanding of these concepts <br> when they are assessed? | Topic assessments | Quantitative |

The following results allowed the researcher to answer these questions about the strengths and weakness of the ISN as an organizational, learning, and reference tool. Subquestions one and four will first be discussed. The quantitative data collected for topic assessments and ISN rubric assessments will be discussed and compared. Next, sub-question
three will be discussed through the qualitative data collected from in-class observations and out-of-class observations when the ISNs were collected will be discussed. Lastly, question two will be answered with the analysis of data collected from the students surveys.

## Topic Assessment Scores and ISN Assessment Scores

Of the fifty-six students that began in the study, quantitative data from fifty-two were analyzed. Two students moved to a different school before their data was collected. Two others misplaced their ISN, therefore their incomplete data were not included.

The quantitative data collected included the three topic assessment scores of topics seven, eight, and nine of the fifth grade enVision Math series. These three topic assessments were twelve to fourteen questions each. A majority of the problems on each test were multiple choice questions. Two of the problems were open-ended response questions, including a gridded response question and a written response question that required students to explain or show their mathematical work and/or thinking. Copies of the three topic assessments can be found in Appendix B. The other quantitative data included is the ISN assessment data. The researchercreated rubric was used to ascertain a score up to twelve for each of the three topic sections in the ISN. The three areas the rubric allowed the researcher to assess for each topic section included the organization of the Table of Contents, the completeness of the class notes for each lesson, the completeness of the independent work for each lesson, and the overall neatness of the topic's notes, guided work, and independent work. As previously stated, a copy of the ISN
assessment rubric can be found in Appendix C. Also, a complete table including the topic assessment scores and ISN assessment scores for each student can be found in Appendix E.

Table 3: Topic Assessment Scores and Averages

| $\qquad$ | High | High Average | Low Average | $\begin{gathered} \text { Total Classes } \\ \underline{\text { Average }} \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| Topic 7 <br> Assessment | 94.7\% | 93.9\% | 82.0\% | 90.2\% |
| Topic 8 <br> Assessment | 95.3\% | 93.0\% | 78.6\% | 89.0\% |
| Topic 9 <br> Assessment | 90.7\% | 93.1\% | 74.8\% | 86.2\% |
| Topic <br> Assessments <br> Averages | 93.6 \% | 93.3\% | 78.5\% | 88.4\% |

Table 4: ISN Assessment Scores and Averages

| Class | High | High Average | Low Average | Total Classes <br> Topic |
| :---: | :---: | :---: | :---: | :---: |
| Topic 7 ISN | 10.7 | 10.6 | 9.5 | 10.3 |
| Assessment | 11.2 | 10.9 | 9.3 | 10.5 |
| Topic 8 ISN |  |  |  |  |
| Assessment | 11.2 | 11.2 | 9.6 | 10.7 |
| Topic 9 ISN |  |  |  |  |
| Assessment |  |  |  |  |
| ISN | 11.2 |  |  | 10.5 |
| Avsessment |  |  |  |  |

Table 3 shows the average topic assessment score for topics seven, eight, and nine rounded to the nearest tenth of a percent for each of the three mathematics classes: high, high average, and low average. It also shows the average assessment score for each class as well as the average assessment grade for each topic. Lastly, it shows the average score for all three classes on all three topic assessments.

The average of the high class assessments is the highest, at $93.6 \%$, and the high average group is a close second with $93.3 \%$. The low average group scored an average of $78.5 \%$ on the three assessments. The overall assessment average was an $88.4 \%$, which shows a moderately high understanding of the three topics assessed overall.

Table 4 shows the average ISN assessment scores rounded to the nearest tenth of a point for each class. It also shows the average of these scores for each class as well as for each topic. Lastly, it shows the total average of the ISN assessments for all three classes.

The results show that the high average class had the highest average ISN assessment score with 11.2 , followed by the high class with an average score of 11.1 and an average score of 9.5 from the low average class. An average of the three class's ISN assessment scores for the three topics was calculated for a total average score of 10.5 out of 12 total points. As a percent, this would be calculated as an $87.5 \%$.

Students lost points on their ISN assessment scores mainly for two reasons. Some students did not adequately use their Table of Contents. This means that the page number for a lesson or a number of lessons did not match the page number where the notes and class work for the lesson or lessons were located in the ISN. Other students lost points for not including page numbers at all or not recording the assessment description clearly. Another way students lost points on their ISN assessments were that they were missing complete lessons. This was mainly due to absences from class. Many students in the high class missed class nearly every Thursday when they were pulled out for the gifted program, so they did not receive notes in class during that day. All students, whether absent or in gifted, were instructed to borrow a classmate's ISN
and copy the missed notes, but some students did not do so. Therefore, they lost points for these missing lesson notes.

Lastly, the quantitative data of the fifty-two students were utilized to calculate a correlation coefficient in order to demonstrate whether or not there was a correlation between the students' topic assessment scores and their ISN assessment scores. According to Gay, Mills, and Airasian (2009) a correlation coefficient is a decimal number ranging from -1.00 to +1.00 . A positive correlation coefficient shows a positive relationship between two variables (in this case topic assessment scores and ISN assessment scores), while a negative correlation coefficient shows a negative relationship. In other words, a positive correlation coefficient would allow the researcher to conclude that students with a high score on one of the assessment are likely to score high on the other assessment (Gay, Mills, \& Airasian, 2009). A correlation is not to be used to conclude causation, and it was not done so in this study. The correlation coefficient was calculated merely to demonstrate a connection between how well students performed on formal topic assessments and how complete and organized their ISNs were kept.

Table 5 shows the correlation coefficients rounded to the neared hundredth for each of the three topics. It also reveals the calculated average correlation coefficient for all three topics' assessments. All the coefficients are positive, showing a positive relationship between ISN assessment scores and topic assessment scores. A strong positive relationship is represented by a correlation coefficient between +0.65 and +1.00 , a moderate relationship is represented by a correlation coefficient between +0.35 and +0.65 , and a weak or no relationship is represented by a correlation coefficient between 0 and +0.35 (Gay, Mills, \& Airasian, 2009). A weak or
moderate correlation coefficient is shown for each topic, while a moderate correlation coefficient of +0.40 was calculated for the average of all three topics. This shows that there is a moderate relationship between the students' ISN assessment scores and topic assessment scores. Further conclusions of the correlation coefficient are discussed in the Discussions section.

Table 5: Topic Assessments and ISN Assessments Correlation Coefficients

| Topic | Correlation Coefficient |
| :---: | :---: |
| Topic 7 | +0.33 |
| Topic 8 | +0.40 |
| Topic 9 | +0.47 |
| Average | +0.40 |

## Researcher Observations of the ISN Process

The researcher observed how well students utilized their ISNs starting from the beginning of the school year. Most of the instruction of how to set up, organize, and use the ISN in and out of class was done during the first few weeks of school. As new students joined the class, the researcher paired the new student with another student in the class who could assist with creating the table of contents, numbering the pages, and instructing the new student on how to organize the class notes, guided practice, and independent work. The researcher would also assist and
make sure students were keeping up with the organizational aspects, class notes, and guided and independent work during the class time. A closer look at students' ISNs, however, was not possible until the ISNs were collected after the end of Topics 7 through 9. At this time, the researcher was able to look closely at each student's individual notebook and see if they were keeping their ISNs organized and up-to-date.

Overall, the researcher was pleased with what was observed when the ISNs were collected. Most students were able to keep a daily Table of Contents, with a running list of every lesson learned in class. Most were also able to staple any handouts or extra notes and work that exceeded the space allotted on each input and one output page that was allotted per lesson. It was observed that overall most students' notebooks were well-kept and organized.

There were a few observed problems, however, that will be further addressed and analyzed in the Conclusion chapter of this study. First, as previously stated in the quantitative data description, some students were missing entire lessons, due mainly to absences from school or being in gifted one day a week. Some of the absent or displaced students made a point to borrow a classmate's ISN when they were able to and copy the notes that were missing, while some students did not.

Included in Appendix F and G are scans of pages from two students' ISNs. The student whose samples can be found in Appendix F scored a twelve on the ISN assessment for Topic 7, while the student samples that are located in Appendix G scored a six on the ISN assessment for Topic 7. Included in the scans are the Table of Contents and the input and output pages for lesson 7-4, titled "Common Factor and Greatest Common Factor." The student who scored a
twelve was able to keep the ISN extremely neat and well-organized. Each lesson is clearly written in the Table of Contents, and the input and output sections for lesson 7-4 are also complete and easily read. This student's ISN contrasts greatly from the student who scored a six on the Topic 7 ISN assessment. The Table of Contents is extremely unorganized and is even missing dates and page numbers for many of the lessons, including 7-4 on the bottom of the page. The 7-4 input page has an abbreviated title and a page number that is not found in the Table of Contents. The notes are legible, but they are not as easily read or as complete as the student who scored a twelve. The input notes also carry onto the next page, which is supposed to be for student output only. Students who run out of room on either their input or output section were asked to continue on a separate sheet of loose leaf notebook paper and staple it into the ISN on that page. The output page is also difficult to follow. Problems are not numbered and it is hard to tell what work goes with what answer, or even what the answer is. The differences between the ISNs of students who received a twelve and the student who received a six on the Topic 7 ISN assessment are quite obvious. Using the former students' ISN as a reference tool would be much more helpful than using the latter students' ISN because it is much more complete, more legible, and better organized.

The last portion of the ISN that was observed and reflected upon were the students’ answers to the three reflection questions. These three questions were given at the end of the Topic 9 assessment and covered concepts that were taught during Topics 7 through 9. The reflection questions were:

1. Why must fractions have common denominators in order to be added or subtracted?
2. Describe a real life example when fractions or mixed numbers would be added or subtracted
3. How are mixed numbers and improper fractions alike? How are they different?

Answers for these questions ranged a great deal. Some students showed a deep and strong understanding of the concepts and lessons that were taught during the previously mentioned topics. Others showed a partial understanding, while some showed little understanding or an inability to express their understanding clearly. A more in depth reaction towards the reflection questions answers will be discussed further in the Conclusion section of this research.

## Student Surveys

The student surveys were analyzed both quantitatively and qualitatively. A copy of the survey given to students can be found in Appendix D. Questions two through six asked the students to give their answer based on a scale of opinions. Questions two and four asked how often the students used their math ISN to assist them with homework and studying for tests and quizzes respectively. The answers choices were never, sometimes and often. Questions three and six asked the students if they used the ISN to assist with homework or studying for quizzes and tests and how useful they found them to be as a reference tool. Answer choices were I never used it, somewhat helpful, and very helpful. Question six asked the students how useful they
considered the ISN to be as an organizational tool. The answers choices were not useful, somewhat useful, neutral, useful, and extremely useful.

Table 6 shows the question asked for number two. It also gives the number of responses given for each choice along with a percentage rounded to the nearest tenth of a percent. The data suggests that over $88 \%$ of the students used their ISN for homework assistance, whether it was only sometimes or often. Most students responded that they used their ISN sometimes for homework assistance. This suggests that these students either chose not to use it or they simply did not find it necessary to do so because they do not need the assistance. Only six of the fiftytwo students who filled out the survey responded that they never use the ISN as a reference tool for homework assistance.

## Table 6: Student Survey Question 2 Responses

| Questions 2: How often did you use your Math ISN to assist you |
| :--- |
| with your mathematics homework during Topics 7-9? |


| Responses | Number of Responses | Percent of Responses |
| :--- | :---: | :---: |
| Never | 6 | $11.54 \%$ |
| Sometimes | 32 | $61.54 \%$ |
| Often | 14 | $26.92 \%$ |

Table 7 shows the question asked for number three. It also gives the number of responses given for each choice along with a percentage rounded to the nearest tenth of a percent.

The six students who responded they did not used their ISN for homework assistance in Question two responded similarly for question three. The other forty-six students, again just over $88 \%$, responded that they found it somewhat helpful or very helpful. $67.31 \%$ of the students responded that they found it very helpful, which is larger than the percentage of students who said they used their ISN for homework assistance often. This shows that even if students did not state that they used their ISNs for homework assistance often, when they did so, they found it extremely helpful.

Table 7: Student Survey Question 3 Responses
Questions 3: If you used your Math ISN to assist you with your homework during Topics 7-9, how useful did you find it?

| Responses | Number of Responses | Percent of Responses |
| :--- | :---: | :---: |
| I never used it | 6 | $11.54 \%$ |
| Somewhat helpful | 11 | $21.15 \%$ |
| Very helpful | 35 | $67.31 \%$ |

Table 8 shows the question asked for number four. It also gives the number of responses given for each choice along with a percentage rounded to the nearest tenth of a percent.

The data shown on Table 7 reveals that fewer students used their ISN as a study tool for quizzes and tests than as reference for homework. Only just over 71\% of the students responded that they used their ISN at all as a study tool, while only about $21 \%$ of the students used theirs often. A percent of almost $29 \%$ indicated that they never used their ISN as a study tool for
assessments, which is larger than the percentage who said they never used their ISN for homework assistance. Half of all the students surveyed responded that they sometimes used the ISN as a study tool. This shows that more students stated that they used their ISN for homework assistance then as a study tool for quizzes and tests.

Table 8: Student Survey Question 4 Responses
Questions 4: How often did you use your Math ISN to study for mathematics quizzes and tests during Topics 7-9?

| Responses | Number of Responses | Percent of Responses |
| :--- | :---: | :---: |
| Never | 15 | $28.85 \%$ |
| Sometimes | 26 | $50.00 \%$ |
| Often | 11 | $21.15 \%$ |

Table 9 shows the question asked for number five. It also gives the number of responses given for each choice along with a percentage rounded to the nearest tenth of a percent.

Table 9: Student Survey Question 5 Responses

| Questions 5: If you used your Math ISN to study for mathematics |  |  |
| :--- | :---: | :---: |
| quizzes and tests during Topics 7-9, how useful did you find it? |  |  |
| Responses | Number of Responses | Percent of Responses |
| I never used it | 15 | $28.85 \%$ |
| Somewhat helpful | 12 | $23.08 \%$ |
| Very helpful | 25 | $48.08 \%$ |

The same fifteen students who replied on question four that they did not use their ISN as a study tool for quizzes and tests responded similarly for question five. Of the thirty-seven students who used their ISN as a study tool, however, twenty-five of them, over two-thirds, found it to be a very helpful study tool.

Table 10: Student Survey Question 6 Responses

| Questions 6: How useful do you consider the ISN to be as an |  |  |
| :--- | :---: | :---: |
| organizational tool, i.e. organizing notes, handouts, class work, etc.? |  |  |
| Responses | Number of Responses | Percent of Responses |
| Not useful | 0 | $0.00 \%$ |
| Somewhat useful | 2 | $3.85 \%$ |
| Neutral | 5 | $9.62 \%$ |
| Useful | 20 | $38.45 \%$ |
| Extremely useful | 25 | $48.08 \%$ |

Table 10 includes the question asked for number six. It also gives the number of responses given for each choice along with a percentage rounded to the nearest tenth of a percent.

The data given in Table 10 reveals that about $87 \%$ of the students found the ISN to be useful or extremely useful as an organizational tool, while just under a tenth of the students had a neutral opinion of the ISN as an organizational tool. Only two students found it somewhat
helpful, and not one student responded that they did not find the organizational aspects of the ISN to be helpful at all.

Questions one, seven, and eight were analyzed qualitatively, using color coding to find themes between student answers. Question 1 asked, "In your own words, what is a Math ISN?" One of the themes found was that it was an organizational tool. One student referred to it as a "note holder," meaning that it was a tool where there notes would be stored. Another student stated that it "organizes your thoughts and questions." Another called it an "organized math reference book," while another described the ISN as "very neat and put together and makes things organized."

Another more prevalent theme was that students defined the ISN as a place for their notes and their student work. Students consistently referred to the ISN as a place to keep and "jot down" notes and also a place to keep all the work and problems they solved in class.

The most prevalent theme found in the answers for question one, however, was that the students defined the ISN as a reference tool for homework and studying assistance. The ISN was described by students as a "student reference...[and]guide." Some students specified that they used it as a reference for homework assistance. They stated that it "helps you on homework if you're stuck on a problem or don't understand a problem" and the students were able to "look at it with our homework to clarify." They also referred to it as a study tool for quizzes and tests. One student said that it "helps you study" and is a "study guide."

Question seven asked, "What do you like about the ISN?" The themes found in these answers were similar to the themes found in question one. Two of the themes were that students
found that taking notes and doing their independent class work in the ISN was helpful. The themes that were most prevalent in their answers, however, were that it helped them stay organized and that it acted as a helpful reference. Students were very positive about the ISN's organizational aspects, and liked how they could find their lessons easily using the table of contents. One student responded that "you don't have to have folders," which showed that this student liked organizing all of his or her notes and class work in one place instead of in different folders. Students also responded that the ISN was a useful reference tool. One student wrote that the notes could "show me the steps and examples" needed to solve certain problems. Students explained how they liked the ISN as a reference tool for both homework assistance and studying for quizzes and tests.

The final question on the survey asked, "What do you dislike about the ISN?" This question did not receive a variety of answers. Most students responded that they did not dislike anything about the ISN. Only a few students gave any criticisms. A few students shared a dislike for the writing that was done during note-taking, and another student thought it was "kind of boring." Another shared an idea that there should be a notes page at the end of each topic, which could be used as a reference for studying for a topic assessment. One student disliked the idea of having an input page and output page on corresponding left and right pages instead of having them front and back. One other student disliked writing the lesson title twice, once on the Table of Contents and once on the top of the input page, while a few others disliked the Table of Contents as a whole. These criticisms were found to be few and far between. Most of the students did not have a negative comment to share about the ISN as a whole.

Student assessments, researcher observations, and student opinions were all used to conclude whether or not the ISN affected fifth grade students' understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers. Student assessments included topic assessment test for the Topics 7 through 9 of the enVision Math series and researcher-created ISN assessments. These two forms of quantitative assessments revealed weak to moderate correlations between student achievement on the topic assessments and achievement on the ISN assessments.

Researcher observations included observations of students using their ISNs in class and observations of student work and reflection questions that were completed at the end of the three topics' assessments when the ISNs were collected. The researcher observed that students were able to utilize their ISNs successfully in class, but some lessons were missing due to absences from school or from class due to being in the gifted program. Student reflections revealed a wide variety of understanding of some of the concepts taught.

Lastly, student surveys revealed a wide variety of student opinions about the ISN process during Topics 7 through 9. Students appeared to utilize the ISN as a reference tool more for homework than for studying for quizzes and tests, but a higher percentage of students who did so found it to be a very helpful tool than students who only found it somewhat helpful. Students also revealed that most of them found the ISN to be helpful or extremely helpful as an organization tool. Students also defined the ISN as an organized reference tool in which to keep their notes and independent work, which were the main goals the researcher had for the ISN. Students were very positive about the ISN's organizational aspects and found it to be very
helpful as a reference tool. There were few negative comments about the ISN, but those that were shared were not extremely negative towards the ISN as a class tool, but more about their dislike towards writing and taking notes. A few students, however, did share their criticisms of the Table of Contents.

The next chapter includes conclusions, reflections, and recommendations. Reflections include how useful the ISN was found to be in my mathematics classes during instruction and assessment of Topics 7 through 9 of the enVision Math curriculum. Also included are recommendations of changes and improvements that are being considered for following years if the ISN is utilized once again.

# CHAPTER 5: CONCLUSIONS 

Introduction

The focus of this study was to determine how the use of the ISN tool affected fifth-grade students' mathematical understanding of the concepts and algorithms of addition and subtraction of fractions and mixed numbers. During the three topics of the enVision Math curriculum that was taught and assessed, titled "Adding and Subtracting Fractions with Like Denominators," "Adding and Subtracting Fractions with Unlike Denominators," and "Adding and Subtracting Mixed Numbers", students utilized an ISN, an organized spiral notebook in which they took class notes and completed guided practice problems and independent work. The goal in this research was to see how the utilization of the ISN in the classroom for note taking and guided and independent class work and at home as a reference tool would assist students in their learning and understanding of the addition and subtraction of fractions and mixed numbers concepts.

Both quantitative and qualitative data were collected during this research. Topic assessments and ISN rubric assessments were both collected and analyzed. These assessments were then used to formulate correlations between topic assessment grades and ISN assessment grades. Researcher observations in-class as well as during the collection of the students' ISNs also assisted in drawing conclusions of how complete and organized the students' ISNs were kept during the study. Lastly, surveys were given to the mathematics students, and students were able to give their honest opinions of the ISN process. They shared their opinions on how often
they used the ISN and how useful they believed the ISN was as a reference tool for homework and studying purposes. They also shared their overall likes and dislikes of the ISN as a whole.

## End-of-Topic Assessment and ISN Assessment Data Conclusions

End-of-topic assessments were given at the end of each of the three topics previously described. Also, students' ISNs were collected and assessed using a researcher-created rubric. Each ISN was given a score for each of the three topic sections. These assessments were analyzed quantitatively. A correlation coefficient was then calculated to find a correlation between topic assessment scores and ISN assessment scores. A correlation coefficient of +0.40 was calculated for the average of all three topics, showing a moderate relationship between the students' ISN assessment scores and topic assessment scores. This correlation is not strong and was not calculated in an attempt to lead to a conclusion of causation. It was only calculated to demonstrate a relationship between topic assessment scores and ISN rubric assessment scores. The correlation was calculated as moderate, which does not appear to show a strong relationship between topic assessments and ISN assessments. It is obvious that some students who did not score highly on their ISN assessments were still able to score highly on topic assessments. Also, some students who may have scored well on their ISN assessments did not do the same on their end-of-topic assessments.

The high and high average classes scored closely on both the average topic assessment scores and the ISN assessment scores. The high class averaged a $93.6 \%$ and an 11.2 out of 12 points on the topic assessment score and average ISN assessment score respectively, while the
high average class averaged a $93.3 \%$ on the topic assessments and an average of 11.2 out of 12 on the ISN assessments. The low average class, however, averaged a $78.5 \%$ on the topic assessments and averaged 9.5 out of 12 on the ISN assessment. This data does not allow a conclusion that the high and high average classes performed better on their topic assessments because their ISNs were more organized and complete. There are many factors that could have affected their performances on the assessments, including different mathematics skill levels, different test and quiz study and preparation techniques, and different effort levels. This also related to the correlation coefficient data. There were some students who did not score highly on their ISN assessments but scored highly on topic assessments and vice versa. An inference can be made, however, that those students who were able to keep their ISNs more complete and organized could therefore utilize their ISNs as reference and study tools more effectively and efficiently than those students who kept their ISNs incomplete and unorganized. As Williamson (1997) states, students who are not able to stay organized may suffer from poor grades, stress and low self-esteem. These effects may be due to lost assignments, wasted energy, and general disorder. An organized and complete ISN would obviously be much more useful to a student than a disorganized and incomplete one.

It is also important to point out that many students who received lower ISN assessment scores did so because of missing lesson notes due to absences from class. All students were instructed at the beginning of the school year and reminded often that they if absent, they were to obtain the lesson notes and guided practice problems from a classmate. Some students did not do so when they were absent from school. Others from the high and high average classes were absent from class once a week for a pull-out gifted program. These students would still make up
the homework, even if they did not attain the daily lesson, notes, and guided practice from another student as they were instructed to do. Therefore, students who were highly skilled in mathematics, especially those students in the high and high average classes, could still be successful on end-of-topic assessments, even if they were missing lessons. Other students who were absent, however, and did not possess strong mathematics achievement skills may have found it more difficult to be successful when they were absent and did not obtain the class notes. The issue of student absences and obtaining missing notes and guided practice will be further discussed in the Recommendations section.

## ISN Observations Conclusions

Qualitative data was collected in a number of ways during this study. First, informal observations were made by the researcher during class and when students' ISNs were collected. These observations were shared in the Results sections. Informal observations allowed the researcher to view many of the students' multiple intelligences being showcased. Of the nine multiple intelligences that $\operatorname{Gardner}(1983,1993,1999)$ discussed, students were shown to utilize linguistic intelligence, through student note-taking and mathematical writing, and logicalmathematical intelligence, through both guided and independent mathematics class work. They were also able to utilize spatial intelligence when fraction concepts were represented. Interpersonal intelligence was showcased when students shared their own mathematical strategies and difficulties with the class, while intrapersonal intelligence was utilized when they
answered questions in written form as well as answered the reflection questions at the end of the three topics.

The researcher observed that most students were able to keep an organized ISN. Some students who were absent from class did obtain their notes and guided practice example problems from a classmate as they were instructed. There were some students, however, who did not do so, resulting in missing lessons. A small number of students did have difficulties keeping their ISNs organized. There were some cases where students incorrectly filled out the table of contents, or page numbers did not match where the lesson was located in the ISN. Sometimes, page numbers were missing completely from the table of contents or on the pages where the lesson was located. And there were also times where notes and guided practice problems were copied almost illegibly.

Overall, however, students were very capable in keeping their class notes, practice problems, and independent work in one notebook and well-organized. Most students were quite successful in keeping their ISNs as functional tools for daily note-taking, practice, and reference inside and outside the mathematics classroom. As Ito (2005) states, students' abilities to stay organized in the classroom is extremely important, and it was observed that those students who were able to keep their ISN organized and legible showed success in the classroom.

Collecting the ISNs did, however, result in a number of problems. First, collecting all fifty-two ISNs at once was very cumbersome and time-consuming. Also, because the collection was done only once at the end of the three topics of instruction, using this method as an informal assessment of student understanding of the concepts being taught would not be possible. By the
time any difficulties of understanding were observed, the topics had already been taught, completed, and formally assessed. Therefore, because ISNs were not collected on a regular basis, ISN observations were not shown to be a valid method of informal assessment. This will be discussed further in the Recommendations section.

## Student Survey Conclusions

Another form of data that was collected during this study was the student surveys. These surveys gave a great amount of insight into the students' opinions of how often they used their ISNs and how effective they believed they were as organizational and reference tools. The students' responses were mainly very positive. Students appeared to respond very positively to the ISN's organizational strengths, stating that they enjoyed how easy it was to find what they needed when they needed it. Just as Gambill, Moss, and Vescogni (2008) explained, fifth grade students showed a higher degree of interest and enthusiasm towards the organizational aspect of the ISN.

It was also concluded that students used their ISNs more often as a reference tool for homework assistance than they did for studying and preparing for tests and quizzes. It is believed that students may not have used their ISNs as study tools more often for a couple of reasons. First, it is my opinion that many of the students in my fifth grade classes have not developed strong study skills. Many have not found it necessary to study in order to be successful in school, and therefore, this is not something that they practice. Also, students in my classes received a practice test before each topic assessment that was to be completed for
homework the day before the assessment was given. Therefore, many students used the completion and review of the practice test as a study tool and may not have reviewed their notes and work from that particular topic in their ISN.

The main criticisms students shared in their surveys were that there was too much writing and they did not like writing each lesson to the table of contents. Many students in the fifth grade are not used to taking notes, so for many of them, this was a new experience. Even though it may not be enjoyable for them, note-taking is a popular learning technology in school settings (Kobayashi, 2006). It is a useful skill and one that they need to practice. As Boylf (2001) stated about class notes, the ISN notes were similarly used as both assistance with student understanding of lecture information and as a reference material for later use and study. The table of contents and how changes could be made in that respect will be discussed further in the Recommendations section.

## Recommendations

There are three main aspects of the ISN that should be considered as recommendations for future use. These recommendations included the use or inclusion of a table of contents, absent students and missing lesson notes and work, and the utilization of the ISN as an informal assessment.

The main criticism students shared toward the ISN if they shared any was in regards to the table of contents. It was observed and even shared by some students that the inclusion of the
table of contents did assist students stay organized and easily find their notes and class work for a particular lesson. Many students, however, expressed that they did not like having to copy the lesson title in the table of contents as well as on the top of the page of the teacher input page. This was time consuming as well, taking anywhere from three to five minutes every day for students to do so. That is an average of 15 to 25 minutes per week of instructional time spent merely on preparing the ISN. It is the opinion of this researcher that this time could be used more effectively.

One recommendation would be to have students only copy the full lesson title once, either in the table of contents or on the top of the teacher input page instead of twice. Then they could write simply the lesson number the other time. For example, if the lesson was titled " $8-3$ : Adding Fractions with Unlike Denominators," the students could write the complete lesson title either in the table of contents or on top of the teacher input page while only writing " $8-3$ " on the other page. This could still be time consuming, so another recommendation would be to remove the table of contents completely. Instead of using a table of contents to assist students in finding lesson notes and class work easily, students could use "Post-It" notes and place them at the beginning of each topic section. This way, they could still easily access the topic of lessons that they wanted quickly. Then, because each topic contains eleven lessons or fewer, accessing specific pages of notes and class work would still be quite convenient. This would save the time that was used for daily set-up of the ISN to be used more effectively.

Absent students provided another problem during the implementation of the ISN. First, students were not getting the notes and guided practice problems for the lesson when they were
absent. This would not only affect their ISN assessment, but it meant that students did not have access to these notes and guided practice problems if they were needed for later reference. It is the belief of this researcher that it is important for the students to obtain notes for each lesson, even those for which they were not present. Students expressed how useful they believed these notes could be for homework assistance or as a study tool. If students' notes, however, are incomplete, this results in a less effective ISN.

Student absenteeism is a problem much larger than this action research study, and it is not the goal of this research to discuss this problem in depth. It is the goal of this research, however, to make sure that the ISN is as useful a tool as it can be. Because the ISN was only collected once at the end of the three topics, students were able to have missing lesson notes without resulting in any consequences. It is the recommendation of this researcher, therefore, that it may be more beneficial to the students if the ISNs were collected more frequently for assessment of its completeness and organization. If ISNs were collected once each topic or, at the minimum, once each grading period, and the ISNs were assessed for completeness and organization and given a grade, students may make more of an effort to keep their ISNs more complete. Collecting all the ISNs at once, as previously stated, is very cumbersome. Therefore, if the ISNs were only collected a few at a time each week, they could more easily be assessed for completeness regularly and effectively. To make the assessment even more effective, only a few lessons could be checked and assessed instead of all the lessons included during that period. The students would not know which lessons were being assessed; therefore they may make more of an attempt to not have any missing lessons.

In order to allow students some time to get missing notes, specific time could be given for those students who had been absent to do so. For example, while the homework from the previous night was being reviewed, students who were absent the previous day from school, and therefore do not have that homework assignment completed anyway, could use that time to begin copying the notes and guided practice problems that they were missing. It may not be enough time to obtain the entire lesson's notes, but it does give students time to start doing so.

Another recommendation for the utilization of the ISN in a mathematics classroom is how it is used as an informal assessment. It was hoped that when the ISNs were collected from the students, they could be used as an informal assessment by observing their independent work and written responses. Also, by observing student writing in the mathematics classroom, it was the hope of this researcher that many of the writing elements that Graham and Perin (2007) discussed would be observed and used as an informal assessment. This, however, did not prove to be very probable by using the ISN alone. As previously stated, collecting all of the ISNs at once was extremely cumbersome, and the fact that it was done after three topics, if any misunderstandings were discovered, it was too late to assist students before the topic assessments were given. Also, if the ISNs were being collected on a regular basis to be used for informal assessment, then students would not be able to use their own ISNs as a reference tool as often, because the ISNs would not be in their possession as often. It has been concluded, therefore, that using the ISN as a form of informal assessment of student learning is not valid or very useful. It is the recommendation of this researcher that a different form of informal assessment should be used on a regular basis. Instructors could use a short daily assessment, sometimes referred to as an exit slip or quick check. This daily assessment should consist of four to five problems,
including at least one problem that would require a written response. This would be a much more useful form of regular and informal assessment.

## Final Discussions

It is of the opinion of this researcher that the ISN was found to be a very useful tool that assisted my students in staying organized. It also was a useful reference tool according to the students, even if it did not prove to be valid for assessment by itself. This was due mainly to the difficulty of merely collecting all the ISNs on a regular enough basis to be used to assess student understanding and achievement. It did prove to be a positive experience for this researcher, as I was able to observe students actively using their ISNs in class. It was also wonderful to hear students, via the student surveys, share positive thoughts about the usefulness of the ISN as an organized reference and study tool.

The ISN also allowed students to utilize a number of intelligences inside and outside of the classroom. The intelligences that were triggered included linguistic, through writing in the ISN. Students took class notes on the lessons and concepts being taught in class. These notes included vocabulary definitions, step-by-instructions for addition and subtraction of fractions and mixed numbers algorithms, and guided practice problems, all of which students could utilize for reference if and when it was needed. During independent practice, students were able to write their own explanations in their ISN to answer mathematics problems. This allowed students to utilize their intrapersonal intelligence. Also, students had opportunities to showcase their interpersonal intelligence when they were asked to share answers and strategies with the class as
well as ask for assistance during review of independent practice. Spatial intelligence was used when students were asked to draw and represent certain mathematics concepts in their ISN, including drawing models that represented adding and subtracting fractions and mixed numbers. Logical mathematical intelligence obviously was used with the ISN, as students were asked to solve addition and subtraction of fractions and mixed numbers problems.

The purpose of this research study was not to showcase a ground-breaking curriculum or a new teaching method that would revolutionize how mathematics is taught. The ISN is simply a tool. Students use many tools to assist their success in school. This is one such tool that has shown throughout this study to be effective both inside and outside the classroom. In conclusion, students used their ISNs. Unlike my experiences in past years, when students would take notes only to lose them or never look at them again, students were using their ISNs and most of them shared that they found it to be useful. If the ISN can assist students to be successful in learning and understanding mathematics, as it did during this action research study, then it is the opinion of this researcher that it is a valid tool for any mathematics classroom.

## APPENDIX A: IRB OUTCOME LETTER

University of Central Florida Institutional Review Board Office of Research \& Commercialization
12201 Research Parkway, Suite 501
Orlando, Flonida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276 www.research.ucf.edu/compliance/irb.html

## NOT HUMAN RESEARCH DETERMINATION

From : UCF Institutional Review Board \#1
FWA00000351, IRB00001138
To : Brian J. Twar
Date : November 22,2010

Dear Researcher
On $11 / 22 / 2010$ the IRB determined that the following proposed activity is not human research as defined by DHHS regulations at 45 CFR 46 or FDA regulations at 21 CFR 50/56:

| Type of Review: |  |
| ---: | :--- |
| Project Title: | Initial Review <br> The effect of using an Interactive Student Notebook on <br> the understanding of the concepts and algonithms of <br> addition and subtraction of fractions and mixed numbers <br> for fifth grade mathematics students |
| Funding Agency: |  |

University of Central Florida IRB review and approval is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are to be made and there are questions about whether these activities are research involving human subjects, please contact the IRB office to discuss the proposed changes.

On behalf of the IRB Chair, Joseph Bielitzki, DVM, this letter is signed by:

Signature applied by Janice Turchin on 11/22/2010 10:58:08 AM EST


IRB Coordinator

## APPENDIX B: TOPICS 7-9 ASSESSMENTS

## Name

$\qquad$ Topic 7
Florida Test

1) What is the prime factorization of 24 ? (7-3)
(a) $4 \times 4 \times 4 \times 6=4^{3} \times 6$
(B) $2 \times 3 \times 4 \times 8$
(c) $2 \times 2 \times 3 \times 4=2^{2} \times 3 \times 4$
(C) $2 \times 2 \times 2 \times 3=2^{3} \times 3$
(2) On Tuesday, $\frac{2}{9}$ of the students in a class wore jeans. What fraction of the class did NOT wear jeans? $(7-8)$

(C) $\frac{9}{9}$
(C) $\frac{7}{9}$
(1) $\frac{5}{7}$
(1) $\frac{2}{7}$
(3) Milos and Asha are doing their homework. Milos has finished $\frac{3}{6}$ of his. Asha has finished $\frac{1}{6}$ of hers. How much more homework has Milos finished than Asha? (7-9)
(A) $\frac{3}{6}-\frac{1}{6}=\frac{2}{6}=\frac{1}{3}$
(B) $\frac{3}{6}-\frac{1}{6}=\frac{2}{0}$
(C) $\frac{3}{6}+\frac{1}{6}=\frac{4}{6}=\frac{2}{3}$
(C) $\frac{3}{6}+\frac{1}{6}=\frac{4}{12}=\frac{1}{3}$
(4) Which of the numbers below is an example of a prime number? (7-2)
(C) 12
(c) 18
() 23
() 32
(5) Which equation is represented on the number line shown? (7-10)

(1) $\frac{6}{6}+\frac{2}{2}=\frac{8}{8}$
(1) $\frac{10}{10}-\frac{6}{10}=\frac{4}{10}=\frac{2}{5}$
(c) $\frac{6}{10}+\frac{2}{10}=\frac{8}{20}$
(c) $\frac{6}{10}+\frac{2}{10}=\frac{8}{10}=\frac{4}{5}$

Name
Mark the best answer.
(1) Ms. Levitt put a $\frac{1}{3}$-pound box on a scale and a $\frac{5}{6}$-pound rock on the same scale. Which picture matches an equation you could solve to find the total weight of the two items on the scale? (8-7)
(a)

(ㄹ)

(c)

(ㄷ)

(2) Replace each addend with $0, \frac{1}{2}$, or 1 . What is the best estimate of the sum of $\frac{5}{12}+\frac{5}{9}$ ? (8-5)
(ㄷ) $\frac{1}{2}+1=1 \frac{1}{2}$
(C) $0+1=1$
(C) $\frac{1}{2}+\frac{1}{2}=1$
(1) $1+1=2$

Topic 8
Florida Test
3 Which of the following pairs of numbers has a least common multiple of 36 ? (8-1)
(a) 3 and 12
(B) 2 and 18
(C) 4 and 9
(D) 6 and 8
(4) At a fair, Katie sells $\frac{1}{6}$ of the total balloons and Jacob sells $\frac{3}{4}$ of the total balloons. What fraction represents the total amount of balloons sold? (8-3)
(c) $\frac{1}{6}$
(c) $\frac{2}{5}$
(B) $\frac{3}{4}$
(1) $\frac{11}{12}$

5 If hot dogs come in packages of 6 and hot-dog buns come in packages of 8 , what is the least number of hot dogs and buns you could buy to have the same number of hot dogs and buns? (8-1)
(a) 18
(B) 24
(c) 36
(D) 48



## APPENDIX C: ISN ASSESSMENT RUBRIC

## ISN Rubric

## Student \# <br> $\qquad$ <br> Topic <br> $\qquad$

Table of Contents - $\mathbf{3}$ pts.
3 - Table of Contents includes correct date, description, and page number(s) for each lesson
2 - Table of Contents includes two of the three above
1- Table of Contents includes one of the three above
$0-\quad$ Table of Contents includes none of the three above

## Class Notes (Teacher Input) - $\mathbf{3}$ pts.

3- Notes consistently include corresponding page number, title, and complete classroom notes for each lesson

2- Notes consistently include two of the three above
1- Notes consistently include one of the three above
$0-\quad$ Notes consistently include of the three above

## Independent Work (Student Output) - $\mathbf{3}$ pts.

3- Shows a consistent and complete understanding of each lesson with all or most of the assignment completed

2- $\quad$ Shows an adequate understanding of each lesson with some of the assignment completed
1- Shows little understanding of each lesson with a small portion of the assignment completed

0- $\quad$ Shows no understanding of the lessons with none of the assignment completed

## Neatness - $\mathbf{3}$ pts.

3- ISN is neat and easy to read
2- ISN is adequately neat and handwriting is adequately legible
1- ISN is either somewhat untidy or handwriting is difficult to read
$0-\quad$ ISN is extremely untidy and handwriting is illegible
Total Score $\qquad$ / 12

## APPENDIX D: ISN STUDENT SURVEY

Name: $\qquad$
ISN Student Survey

1. In your own words, what is a Math ISN?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
2. How often did you use your Math ISN to assist you with your mathematics homework during Topics 7-9?

Never
Sometimes
Often
3. If you used your Math ISN to assist you with your homework during Topics 7-9, how useful did you find it?

I never used it Somewhat helpful Very helpful
4. How often did you use your Math ISN to study for mathematics quizzes and tests during Topics 7-9?

Never
Sometimes
Often
5. If you used your Math ISN to study for mathematics quizzes and tests during Topics 7-9, how useful did you find it?
I never used it Somewhat helpful Very helpful
6. How useful do you consider the ISN to be as an organizational tool, i.e.
organizing notes, handouts, class work, etc.?
Not useful Somewhat Useful Neutral Useful Extremely Useful
7. What do you like about the ISN?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
8. What do you dislike about the ISN?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## APPENDIX E: TOPIC ASSESSMENTS AND ISN ASSESSMENTS DATA



## APPENDIX F: STUDENT ISN SAMPLE SCANS - ISN ASSESSMENT

 SCORE OF 12| 10 | Table of Contents |
| :---: | :---: |
| $\underset{\sim}{\infty} \quad 7$ | Description Page |
| - $12 / / 10$ | Topic 7 Review What You know 100 |
| - 12/2/10 | 7-1 Understanding Factors 101,102 |
| - 12/6/10 | 7-2 Prime and Composite Numbers 103,104 |
| - 12/710 | 7-3 Finding Prime Factors 105,106 |
| $\rightarrow$ 12-8-10 | 7-4 Common Factors and Greatest Common Factor 107,108 |
| $\square 12-9-10$ | 7-5 Fractions in Simplest Form 109,110 |
| $\bigcirc \quad 12-10-10$ | 7-7 Adding Fractions with Like Denominators 111,112 |
| 上 $12-3-10$ | 7-9 Subtracting Fractions with Like Denominators 113,114 |
| - $\square^{-1}$ | Topic 8 Vocal. 115 |
| $\stackrel{1}{\square}$ 12-15-10 | Topic 8 Review What You know 116 |
| $\square$ | 8-1 Commen Muitiples and Least Common Multiple 117,118 |
| Ho $1-4$ | 8-2 Finding Common Deriominators 119120 |
| $\bigcirc \quad 1-5-11$ | 8-3 Adding Fractions with Unlike Denominaters 121,122 |
| - $1-6-1 \mid$ | 8-4 Subtracting Fractions with Unlike Denominators 123,124 |
| $\cdots \quad \mid-7-11$ | 8-5 Estimating Sums and Differences of Fractions 125,126 |
| $\rightarrow 1-10-1 \mid$ | 8-6 More Adding and Subtracting Fractions 127,128 |
| B $\|-\|\|-1\|$ | 8-7 Draw a Picture and Write an Equation 129,130 |
| en |  |
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| - |  |
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| e. |  |
| e. |  |
| - $\quad 1$ |  |
| $\cdots$ |  |
| 0 |  |
| c |  |



Method 2: Use prime factorization (factor tree)
3. 28 and 42

1. Find prime factors of each number.

| 28 | 42 | $28: 2 \times 2 \times 7$ |
| :---: | :--- | :--- |
| 11 | 11 | $42: 2 \times 3 \times 7$ |
| $4 \times 7$ | $7 \times 6$ |  |
| 111 | $1 / 1$ |  |
| $2 \times 2 \times 7$ | $7 \times 2 \times 3$ |  |

2. List the prime factors of each number.
3. Circle the factors that both numbers share.
4. Multiply the common factors.

$$
\begin{aligned}
& 2 \times 7=14 \\
& G C F \text { is } 14
\end{aligned}
$$



## APPENDIX G: STUDENT ISN SAMPLE SCANS - ISN ASSESSMENT

## SCORE OF 6

table of contents
$1914 / 10$ uh arder of operations
19810 4-3 expressions
19) 410 act ifont ank use roworng
 14) $11104-6$ solving mult and Divi. equations $102210^{4-1}$ Drawapicture andrite aneaction 72 7 7 Topic 5 vocat ordered pairs
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of jecmius

$$
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$$

$6-7$
$6-8$
$6-9$
adding dec ma 18
sub. decmals mix $\partial$ ec mals
$6-10$
malt. Stre problmes
$7-1$
vocab
7-1 understanding fartocs

prone and compiset num ${ }^{\text {ors }}$
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