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Improving middle school math achievement using a web-based program and extended written tasks

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IMPROVING MIDDLE SCHOOL MATH ACHIEVEMENT USING A WEB-BASED PROGRAM AND EXTENDED WRITTEN TASKS

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ABSTRACT

This thesis outlines a dual-intensity approach using a web-based program, MyMathLab, for procedural fluency and, in parallel, extended written tasks for helping students improve their reasoning skills, to learn to use multiple representations, and securing mathematical knowledge. The new Common Core State Standards have increased expectations and achievement goals at all grade levels, the required changes being most significant at earlier grade levels (in elementary and middle schools). It is my assertion that a combined approach, one that encompasses both procedure-oriented practice for fluency and extended written tasks designed to stretch thinking and reasoning is needed to meet these goals.

CHAPTER 1: INTRODUCTION

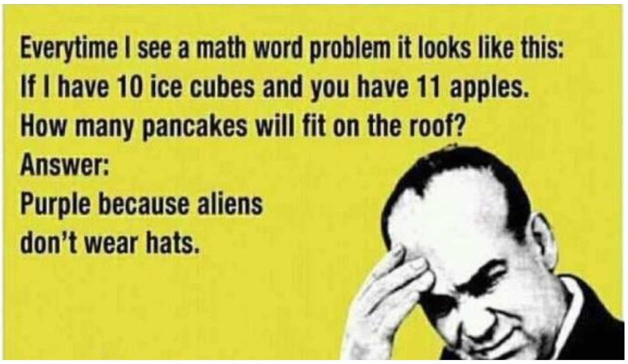


Figure 1: The Problem (AbsolutelyMadness, 2012)

Unfortunately, most middle school math students feel the same way about word problems. There should be a way to soothe their anxiety and strengthen their ability in tackling complex mathematical concepts, but it will take innovation on the part of teachers and school districts alike. This thesis outlines a strategy that has proven to be promising in one such middle school math classroom.

The need for transformation in mathematics education is not a new topic of discussion. The Center on Education Policy (Usher) reported in the their 2009-2010 findings that "an estimated 38% of the nation's public schools did not make AYP (Adequate Yearly Progress) in 2010". (Usher, 2009-2010) The data from various regions in the country is as diverse as the nation itself, and the underlying reasons for the failures of these schools are equally complex. However, in the age of technology that we now live, it is untenable to think that we cannot harness the fascination children have with computer technology in general (strategic games and their spectacular graphics in particular) and channel some of that enthusiasm in the direction of mathematics education.

Jahnell Jones Nichols notes in her book, A Story of Achievement in Areas Where Others Fail (Nichols), American students still fall behind international students in studies on math achievement. Not only that, but she further states that the gap between high performing and low performing students is greater in the United States than in any other nation participating in the studies (Nichols, 2007).

While our students are suffering with low achievement in school, more and more the lack of achievement there follows them into adulthood and their earning potential. Mayer and Peterson note the strong relationship between math achievement and earning potential in their book, Learning and Earning (Mayer). According to the Alliance for Excellent Education Fact sheet, fully one-half of the American students tested below the baseline problem solving skills necessary in the workforce, and one-fourth of them below the level necessary for math computations in every day life. (AFEE, 2008) If the achievement levels remain stagnant at best, and below many of the industrialized nations of the world, we are leaving our students and our society in a potentially desperate situation when it comes to a global economy.

During the last decade, many educational strategies were promoted to increase achievement levels and create an environment of success in every classroom. Marzano and Pickering promoted their strategies for classroom effectiveness in their book, Classroom Instruction That Works (Marzano, 2001).

Marzano's strategies are well documented and discussed frequently in educational settings. They are:

1. Identifying Similarities and Differences

2. Summarizing and Note Taking
3. Reinforcing Effort and Providing Recognition
4. Homework and Practice
5. Cooperative Learning
6. Nonlinguistic Representations
7. Setting Objectives and Providing Feedback
8. Generating and Testing Hypotheses
9. Cues, Questions, and Advanced Organizers (Marzano, 2001)

To encourage students in a mathematics classroom, a place that for many represents all of their weaknesses and none of their strengths, adopting Marzano's strategies makes even more sense. Note taking, a key tool in any class, is often left out of the math student's tool kit. However, when viewed as a "cheat code" for an online math lesson, the student is easily motivated to take notes, to do so accurately and to keep his/her "cheat codes" (lecture notes) for further referencing.

The strategies Marzano has identified represent a common sense approach to effective teaching and are certainly not new. However, although our teachers are receiving professional development in these types of strategies multiple times each year, math achievement is stagnant at best. It is apparent that more efficient ways of implementing these strategies to help our students overcome their deficits and reach their math potential must be explored.

My project involved my 4th block seventh grade math class. It consisted of 24 students of varying math backgrounds. The population was comprised of 19 African American students, two Hispanic, and three Caucasian students. There were 10 girls and 14 boys in the class. From September 15, 2011, until March 23, 2012, the students had 40 minutes every Wednesday in the computer lab to work on

MyMathLab, the web-based math program we have access to under the umbrella of Louisiana State University's College Readiness Program. Using online resources from Pearson Education, I arranged the assignments and chose the problems from a Pearson Pre-Algebra online database to align with the Louisiana Comprehensive Curriculum we were using. We had traditional lessons in the classroom, and then the students had practice on the computer instead of worksheets for approximately half of the time. The students also had access to laptop and desktop computers in the classroom on Thursdays and Fridays as needed to finish their online assignments.

Starting in the second semester, we began to practice for the iLEAP, Louisiana's standardized achievement test. As part of that preparation, we worked on constructed response items, in particular extended constructed response items requiring more than cursory answers. Every other Friday, we worked the extended response items in class, both in groups and individually. To practice the written responses, and to help the students "see" what a full response looked like, we worked one version of an item together. We talked through the question, discussing the meaning, the possible solutions, and the necessary knowledge a student needed to answer the question. We then, as a group, came up with what we deemed a complete answer. After fully answering the original version, I gave the students an extended version of the same question to work on independently. The extended version included parts of the question that required the student to write out the "knowledge" we had discussed, the prerequisite steps needed to solve the different aspects of the item. The purpose of these extensions was to keep the student

engaged in the particulars of the problem by continuing to refer back to the given information to answer each part. The hope is that the more familiar the student becomes with the given data, the more likely he is to gauge the accuracy of his answer rather than putting down a response and moving on without further consideration.

It is the combination of the web-based program and the in-depth practice of the written response items that I am looking at to improve conceptual understanding and enhance long-term memory of math procedures and fluency. With the advent of the Common Core State Standards, a new method of evaluating student achievement on the horizon, and the bleak recent history of our math achievement behind us, new strategies for helping our students meet their potential must be developed. This is one such strategy.

This thesis will try to demonstrate the effectiveness of the incorporation of a high intensity, dual approach combining a web-based program to practice for procedural fluency as well as scaffolded tasks that compel the students to use prior knowledge, abstract reasoning, and multiple representations to find solutions. The "results" are not based on a set of reliable, cumulative data – and considering the sample size I did not even attempt to go in that direction. However, my positive experiences and impressions resulting from this "dual intensity" project are supported by at least two data driven perspectives. One such perspective is from the newly implemented Value-Added STAR (Student Teacher Achievement Result) score the state of Louisiana is now giving to every teacher. The STAR score (a compilation of all students' performance on the LEAP, iLEAP, or EOC) indicates

whether the students in a teacher's classes met their growth expectations or not, or exceeded them. The expected growth is derived from a student's past test scores, attendance, socio-economic status, and learning exceptionalities, if present. The scale for the teacher's score represents the entire group of students taught and ranges from -22 to 22. A score of zero indicates the students met their achievement goal, but did no better or worse than expected. A negative score indicates the students as a whole fell short of their expectations, and a positive score indicates the students as a whole exceeded the growth expectations. A teacher's effectiveness is rated based on how far that value is from the mean, which is zero. Figure 1 shows my STAR scores for the 2010-2011 and 2011-2012 school years.

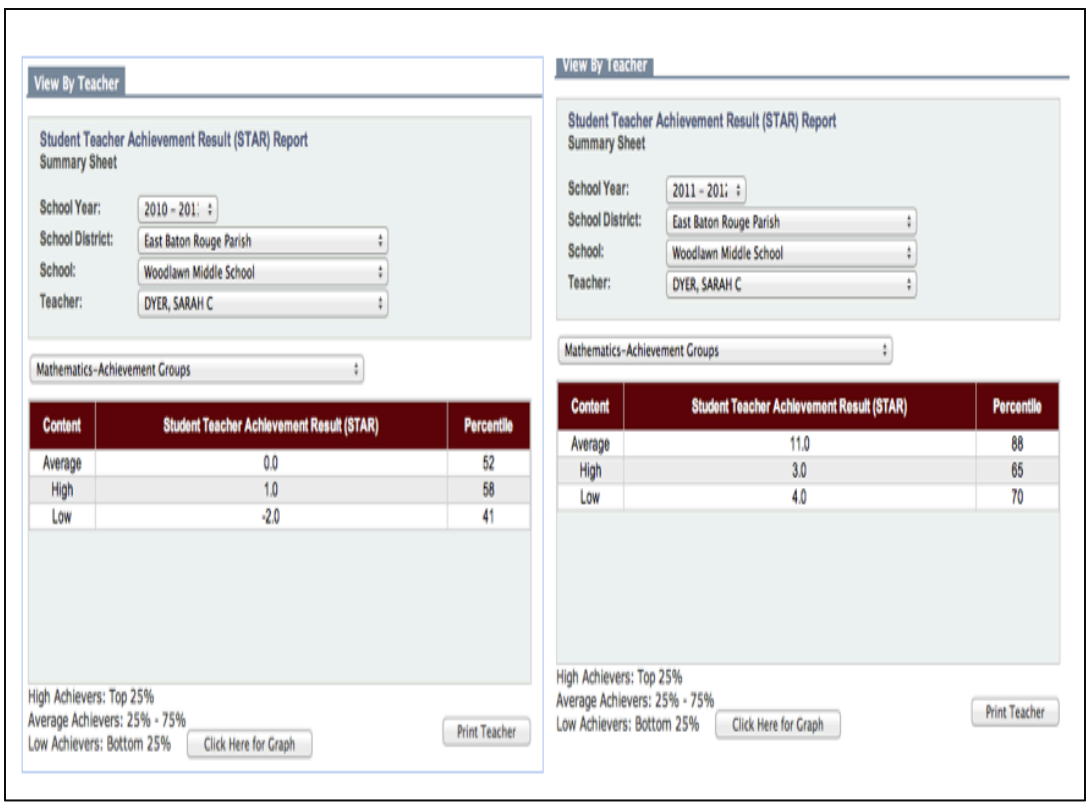


Figure 2: STAR scores for 2010-2011 and 2011-2012

During 2010-2011, I used MyMathLab without pairing it with extended written response items or tasks. The results were disappointing for me. However, during the 2011-2012 school year, I used the combined approach to be described in my thesis and the results improved significantly. Note, the low students had a 6-point swing, meaning they went from not achieving their expected growth (negative number) in 2010-2011 to exceeding their projected growth (positive number) in 2011-2012. This data is one piece of evidence that this combined approach can work and may be a valuable tool for reaching the low achieving students.

Other evidence will be given in subsequent chapters in terms of the students' achievement levels on the parish-wide benchmark assessments. However, for me the most relevant point is that I know for certain, without having compelling scientific evidence to prove it, that I can be a more effective teacher by using the dual intensity approach described next.

CHAPTER 2: LITERATURE REVIEW

According to the National Assessment of Educational Progress report in 2008, seventeen year olds showed no significant improvement over scores from 1974 or 2004. The report also showed that nine year olds and thirteen year olds showed the highest scores over the previous reporting dates (Rampey, 2009). While the trend for the younger students is moving in the upward direction, the percent of students scoring proficient is still alarmingly low. With more and more students entering college being recommended for developmental courses, and only roughly one-third of them completing the math sequence (Hodara, 2011), reforms in mathematics education are needed to ensure the improvement in achievement for struggling students. Hodara studied pedagogical reforms as a means to improving math achievement and course completion for remediated math students. Hodara references the book, Adding It Up: Helping Children Learn Math (Kilpatrick, 2001), and the author's use of the phrase "mathematical proficiency" as a catch-all denoting successful mathematical understanding (Hodara, 2011). Part of the justification for Hodara's study was the assertion by Kilpatrick (2001) that there are five interconnected strands of mathematical proficiency that should be addressed simultaneously, not separately as is often the case. Those strands are: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. *Conceptual understanding* is defined as comprehension of mathematical concepts, operations and relations. *Procedural fluency* refers to skill in carrying out procedures flexibly, accurately, efficiently and appropriately. *Strategic competence* is the ability to formulate, represent, and solve mathematical problems.

Adaptive reasoning measures the capacity for logical thought, reflection, explanation and justification. *Productive disposition* is an habitual inclination to see mathematics as sensible, useful, and worthwhile. This inclination is coupled with a belief in diligence and one's own efficacy (Kilpatrick, 2001). If these strands are not blended together in students at the dawn of their educational journey, there will be deficiencies down the road. Hodara's study looked at forms of instruction to encompass the five strands at once rather than separately.

One tool of reforming the math classroom to include the five strands is computer-based learning. Ideally, computer-based learning encompasses several approaches to learning including metacognition (using higher order thinking to actively monitor thought), multiple representations of problems, procedural fluency and applications. There is a wide range of computer software that covers varying pedagogical approaches, some tutorial in nature focusing on drill and practice, others utilizing problem solving requiring deeper conceptual understanding and thinking (Hodara, 2011). The study found several other positive aspects of computer-based learning. One such aspect is the student-centeredness of the format. The student becomes an active participant in the learning process, not a passive recipient of knowledge. Computer-based learning is also a form of mastery learning (Hodara, 2011), where content is divided into small units a student must master before progressing to the next unit. Studies show that low-performing students progress best using the mastery model rather than traditional instruction (Davis, 1995, December). The mastery model incorporates group collaboration, peer tutoring, and extra time to get the student to a predetermined goal before

continuing to the next unit. The mastery model holds proficiency level constant with time as a variable, while the traditional model holds time as a constant and proficiency varies (Davis, 1995, December). The age -old wisdom is that learning is a function of time spent on task.

According to the NCTM, fundamental principles in mathematics education include developing mathematical literacy, supporting students' mathematical "habits of mind", and nurturing a positive attitude and curiosity towards mathematical thinking (Rubin, 1999). Rubin takes the position that technology in mathematics education must be a means to upholding these principles and furthering the mathematical knowledge of students.

The phrase mathematical literacy stretches far beyond the idea of computational literacy, reaching into the area of critical analysis of statistical and geometrical information and displays, and interpreting different representations of mathematical statements and quantities. When referring to mathematical "habits of mind", the author is pointing to students' ability to engage in mathematical dialogue in logical, thoughtful ways. Nurturing a positive attitude towards mathematical thinking and dialog is key to students embarking on a journey of lifelong learning. The value of technology in the classroom should be measured with these principles in mind (Rubin, 1999). As one researcher states, "Technology alone does not translate to improved instructional outcomes; they matter only when harnessed for particular ends in the social context of the classrooms." (Fitzpatrick, 2001).

Fitzpatrick designed a study to describe students' experience with technology in their math classes. She notes that while investment in technology has

steadily increased, there is little data documenting how students are being affected mathematically (Fitzpatrick, 2001). In her study, students used a computer-based learning system two days per week for forty minutes each day, and spent the remaining three days with a teacher in a traditional class setting with the state approved curriculum and textbook. Over a ten- week period, she was able to document student engagement and gather data concerning students' attitudes towards their math classes through personal interviews. Fitzpatrick found, through direct questioning, that students felt they had more control over their learning goals using the interactive technology program. Specifically, they expressed the positive aspect of being able to move at their own pace, not being forced to learn at another's pace. Students instinctively began to identify those in the class working at their pace, and would partner up to work together. This promoted collaboration and math-talk in the classroom unprompted by the teacher. The ability to communicate understanding to another student provides evidence of conceptual understanding.

Another aspect of the computer-based program was the students' ability to use immediate feedback to interpret, analyze, and improve their own math performance (Fitzpatrick, 2001). The students quickly learned to use the internal progress tracker in the program to chart their own progress, find gaps in their understanding, and plan make-up work if necessary. When the immediate feedback provides the correct answer on a missed problem, the students had the ability to analyze their work immediately and correct any mistakes in computation or understanding.

It should be noted that studies indicate that self-efficacy is an important factor in attitudes and achievement levels (Joo, 2000). In math classrooms that incorporate technology, a student may face double doses of doubt, in math competency and computer literacy. The teacher must take precautions to promote a positive attitude toward web-based instructional tools to ensure the student is not held back due to low self-efficacy in the computer arena. Expectations regarding web-based instruction must be modified as self-efficacy towards computers improves (Joo, 2000).

If the role of technology is to increase math literacy or math proficiency in students at all levels, then the question "What determines successful performance on complex problem-solving tasks ranging from mathematical computations to analogical mappings?" must be answered (Beilock and DeCaro, 2007, para 1). Beilock and DeCaro performed a study to answer that question from the cognitive and developmental psychology points of view. They were interested in determining how the strain on working memory affected success on high stakes assessments. Their study involved several highly structured and monitored tasks involving high level math problems. Some were deemed high stakes (pressure inducing), and others were not. The goal was to determine how performance on pressure-intensive tests were affected (or not) depending on how the tasks were approached or solved. Generally speaking, there are two approaches at work in reasoning and problem-solving tasks. Those approaches are described as associative processes and rule-based processes (Beilock and DeCaro, 2007). The associative process involves relating to similar experiences built up over time. It is believed that these

associations occur naturally without taxing working memory for recall. Rule-based processes rely on remembering algorithms for specific problems, some very complex and symbolically represented, to compute solutions. This process, because it places high value on memory rather than associations, places high demands on working memory. The important observation of this study was that the participants entering with high capacity for working memory were most adversely affected on a high stakes assessment. If students who are otherwise highly capable are performing at levels below their actual ability because they are relying too heavily on “rules and algorithms”, there is room for improvement in how we communicate mathematical concepts.

Understanding the role of working memory is key to the development of educational strategies that successfully blend the two approaches to maximize success for our students. In Rubin’s study, web-based instruction can have a two-fold affect on student achievement. By offering the ability to create dynamic visual representations for problems, students can connect a mathematical expression to a cognitive visual experience (Rubin, 1999). This ability has the potential to help the student create associations that would reduce the strain on working memory. Rubin further asserts that technological advances such as calculators and computer programs help remove computational barriers and give students an avenue into deeper mathematical inquiry (Rubin, 1999). While it is generally agreed that students should have a basic understanding of numeracy and be competent in basic arithmetic, the time has passed for students to sit for hours on end computing long division with five-digit divisors. Rather, when the basic concept is understood and

the student is competent, time is better-spent developing number sense and problem-solving ability, of which basic arithmetic is only a part. Web-based programs enhance the students' interest and positively affect their attitudes towards this end (Fitzpatrick, 2001).

While becoming proficient in basic arithmetic is not the goal of computer-based instruction, the advantages of web-based programs providing practice and immediate feedback cannot be ignored or understated. Deficiencies in basic math skills in the classroom typically lead to inaccurate computation that creates obstacles in problem solving (Hudson, et al, 2010). In their article, Hudson, Kadan, Lavin, and Vasquez note three common causes: lack of prior knowledge, negative attitude towards math, and varied teaching methods. Because math education naturally scaffolds, misunderstanding of key concepts interferes with progress. Researchers agree that the longer a problem in understanding persists, the more difficult remediation becomes (Hudson, et al, 2010).

Web-based instruction can be used to strengthen understanding of basic skills in mathematics. When combined with other aspects of differentiation (peer tutoring, collaboration, manipulatives, note-taking), technology integration can become a vital tool in increasing student achievement (Hudson, et al, 2010). In their released standards for the teaching of mathematics, the NCTM lists technology as one of its six principles. "Technology is essential in teaching and learning mathematics; it influences the way mathematics is taught and enhances students' learning," (NCTM, 2000, p. 3). The standards clearly specify that the use of computers cannot and should not replace teaching towards understanding, but can

and should be used to promote and foster those understandings and intuitions. In referencing Bowes (2010, p.10), Hudson re-emphasizes, “Technology supports achievement, enabling learners to be independent, competent, and creative thinkers as well as effective communicators” (Hudson).

In his book, Education Nation, Chen makes the case for one-to-one computer ratios in public schools. The arguments are many, but central to them is the idea that shared technology (four students: one computer) dilutes the learning opportunity. The litmus test, in his opinion, should be three questions. They are:

1. Do you have a computer?
2. Would you give up your computer?
3. Would you share your computer with three other people? (2010, p. 87)

Of course, in the professional world the idea is almost silly, yet it persists and even thrives in the educational setting. The NCTM standards recognize that our students are growing up in a technologically advanced world (Rampey, 2009) and that to be competitive they must be proficient in its use. The implementation of technology based math instruction is a fundamental step that needs to be taken if we are to truly prepare our students for a global market. (NCTM, 2000) These technologies go far beyond a computer and calculator for drill and practice. They would include simulation/modeling programs such as Mathematica and Excel, as well as laboratories in which to conduct math activities in much the same way a physics lab facilitates science experiments and research. Technology in the math classroom should include all the necessary tools for students to truly do math, not just practice algorithms out of context.

While there is no doubt that changes in math education are needed, and computer technology can and should play a big part, not all computer activities are designed to promote critical thinking, cooperative communication that leads to problem solving, or enhanced conceptual knowledge or understanding. To this end, several articles have been written underscoring the need for measuring conceptual understanding, but more importantly the necessity and know-how to teach conceptually. In their study at Brewer Elementary, a Georgia public school, Collins and Yates noted some important steps in creating an atmosphere conducive to broadening conceptual understanding. In their paper, Math Island (Collins, 2006) they document the student-centered lab's affect on the 475 students enrolled in the school. Classes made regular visits to Math Island, where they had access to manipulatives, computers, learning specialists, and cooperative grouping for activities. The teachers were also part of continued training for Math Island, to learn the process of becoming a facilitator in such and environment. The teachers recorded student attitude changes in math, as well as improved work. The students were encouraged to write about their processes, successes, and their overall feeling of achievement in math. The students were given investigation activities, and were able to work cooperatively, engaging in "math talk" that demonstrated conceptual understanding. Open-ended questions gave rise to group discussions concerning problem solving strategies and techniques. The year Math Island was introduced in Brewer Elementary, the students met their academic progress goal in mathematics for the year. While the school remained in the Needs Improvement category because

of deficiencies in other areas, the students had made gains in math achievement (Collins, 2006).

According to the NCTM, math discourse is the way ideas are exchanged in the classroom (NCTM, 2000). It is the way thinking is expressed, ideas are agreed upon or disagreed upon, and how the meaning behind the ideas is understood.
It is shaped by the tasks the students are engaged in, and by the learning environment itself (de Garcia, 2011). Discourse in the math class is essential to developing and demonstrating conceptual understanding. According to the Common Core State Standards, "A hallmark of a students understanding is the ability to justify…a student who can explain the rule understands the mathematics." (pg.4). Generating math talk in the classroom is an important aspect of teaching students to verbalize their thoughts concerning a concept, and helps the teacher gain access to the misconceptions the students may be unintentionally harboring. De Garcia references "Talk Moves" (Chapin, O'Connor, and Anderson, 2009) in her article as a means to get students talking freely but in a directed setting. The idea is to have students re-state others' comments, agree or disagree with their peers, make improvements on the comments of others, or re-voice a comment in their own words (de Garcia, 2011). To measure conceptual understanding, it is important to get into the thoughts of the students. Discourse in the math classroom is as important to gauging math understanding as performing algorithms.

Math tasks are an important tool in creating avenues for discourse. According to the Common Core State Standards (CCSS), Mathematical Practice 3 is the ability to "construct viable arguments and critique the reasoning of others"

(National Governors Association Center for Best Practices, 2010). When students are engaged in tasks that require more than a cursory knowledge of arithmetic, when they must decide on a plan of action and then accomplish it, an entirely new level of communication and thinking opens up.

The literature suggests that a combined approach, one that encompasses both procedure-oriented practice for fluency and tasks designed to stretch thinking and reasoning is needed. This thesis outlines a dual-intensity approach using a web-based program, MyMathLab for procedural fluency and, in parallel, extended written tasks for helping students to improve their reasoning skills, to learn to use multiple representations, and securing mathematical knowledge. The MyMathLab environment and its effects on student learning is described in Chapter 3, while in Chapter 4 some of the extended tasks I created for use in my classes are discussed.

CHAPTER 3: MYMATHLAB – A WEB-BASED MATH PROGRAM FOR PROCEDURAL FLUENCY

3.1 INTRODUCTION

MyMathLab is a web-based program run by Pearson Education. When I began using Pearson, the particular program I used was called MyMathLab, but has since been renamed MyLab and Mastering. Pearson Education has a wide variety of formats in all four core areas, as well as resources for intervention classes, such as English as a Second Language (ESL) and Response to Intervention (RTI) (Education). An exciting new area of development is TAP2LEARN, an application for iPAD that would allow the student to have all of their core material downloaded to one device, accessible at school and at home. Pearson already has many products that are supposedly aligned to the Common Core State Standards, with more becoming available all the time. There is a multitude of online texts and other programs from which to draw material, including Pearson texts, MathXL, Prentice Hall texts and Math Navigator. The database that I used for my regular 7th grade class was a Pre-Algebra E-text by Pearson. While the problems in the text were designed for Pre-Algebra students (making nearly 50% of the problems above the ability level of my class), I was able to find enough material to challenge my students and strengthen their procedural fluency.

One of the goals I set for my students was to learn to use resources available to them independently before calling for my help. Students are masters at finding ways to get answers without actually developing math reasoning or capabilities. An online math program such as MyMathLab is no different in that the students will

look for ways to input correct answers with no real math knowledge attached to the acquisition of said answer. One apparent weakness of the MyMathLab program (if not installed and administered properly) is that a student can learn quickly how to manipulate the system to arrive at the correct answer, but cannot do the same problem independently. For example, built into every page were help options that included viewing an example, watching a video example, help me solve this problem and viewing the textbook. Many students learned within hours that if they clicked on the view an example tab, a problem very nearly identical to the question they were working would open in a new window. All a student needed to do was follow the template in the example and the correct answer would flow out naturally. Another example of students learning to "game" the system came with the "solve a similar problem" tab. If they had an incorrect answer, they could solve a similar problem, meaning one almost the same, to change the incorrect answer to a correct answer. These aspects are a couple of the criticisms educators have with this particular program. A way around them can be found in the administrator panel of the program. The teacher maintains the capability of turning the help tabs on and off, as well as limiting the number of chances a student has of answering the individual problems. A carefully monitored lesson will have the help tabs on for a few problems, then off for the rest. The challenge is to lead the students into the awareness that they can create their own help tabs in their notebooks as they work through the lesson.

If a student was unable to solve a problem on his own and his notes were of no value to him, these tabs on the page offered him private, individualized help. Of

course, I was there to offer assistance if needed, but I insisted they use at least one help tab before calling me. Two samples of the same question page are below. Figure 3.1 shows the question page with all the help tabs in view in the top half, and shows a similar problem page, with the help tabs hidden at the bottom. This shows how a teacher who is actively monitoring the progress of the students can modify the help tabs, using all or none or any configuration deemed necessary for the betterment of the student.

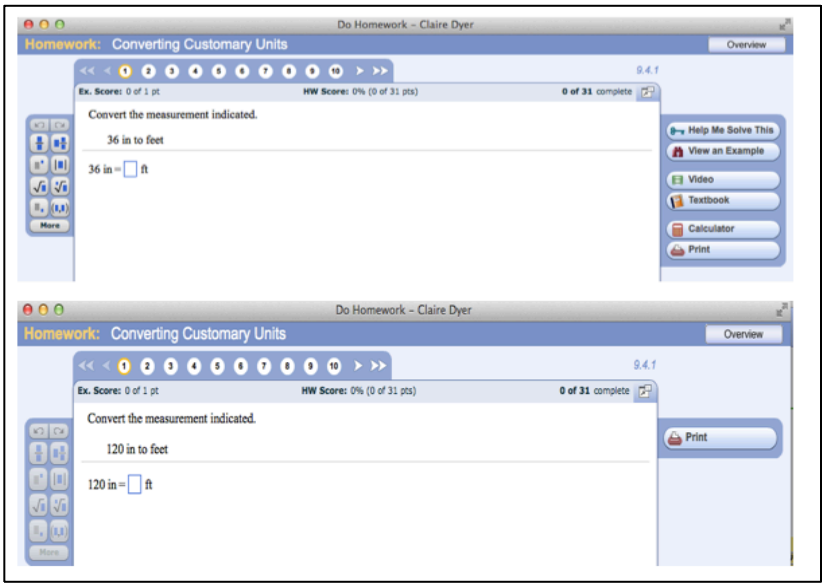


Figure 3.1: Example of MyMathLab Lesson Page

These help tabs can be individually set so that a student can receive the type help tab that meets his learning style. Each student could possibly have his own standard for how many problems can be solved with help before moving towards working problems with no help at all. The program is flexible in that regard, all it takes is careful monitoring by the teacher and communication between teacher and student.

Another aspect of the computer program is that the students were able to work at their own pace, which is a form of differentiation that will be discussed in

more detail in Chapter 4. Since there was no pressure to keep up with the pace of other students during a class period, the students were more relaxed and worked more diligently and independently.

3.2 PROCEDURES FOR MYMATHLAB

My class had a routine for working in MyMathLab. We had traditional lessons that followed our curriculum on Monday and Tuesday of each week; with traditional homework or practice from either our state approved text or worksheets. The first time they logged on to the website, each student completed the MyMathLab tutorial as their first assignment. This tutorial taught them how to input fractions and other math symbols that are not on the keyboard. On Wednesday, we would have an abbreviated lesson, review what had been previously learned and have some instruction concerning what they would see in their computer assignment. Often, I would pull up the lesson on the whiteboard and show them potential hazards for certain types of problems.

I reserved the computer lab every Wednesday for the second half of the 90-minute block. The students had approximately 40 minutes each Wednesday to work in the MyMathLab during the school day. We were able to borrow laptops from LSU allowing them to have approximately 50 minutes each Thursday and sometimes 30 minutes on either a Tuesday or a Friday, depending on our schedule, to work on the assignments. Due to the economic situation of some in our school population, five students only worked on their assignments during the school day because they had no Internet access at home. A varying number had intermittent Internet

connectivity due the transient nature of our culture and other economic or technological issues. It was important to me that the students had the opportunity to complete their assignments. My principal worked diligently to ensure that along with the laptops from LSU I had enough classroom computers for each student to have consistent, independent computer time.

When I assigned work in MyMathLab, the assignment usually consisted of between 25-40 problems, depending on the difficulty of the lesson and the amount of review problems I put in. The deadline for completion was usually Friday evening, since they would have had class time to work on it. Once the deadline passed, the student was locked out of the assignment and could only gain access if I re-opened it, either on an individual basis or class-wide. I used MyMathLab for practice assignments, quizzes, and reviews for tests. At each grading period, I used the overall grade in MyMathLab as a test grade.

3.3 STUDENT PRACTICES

The students began to work in the computer lab in manner that I found acceptable on the third Wednesday. At first, they were unable to appreciate the value of the program and the opportunity they were being afforded by having the licenses donated to them. These licenses, which cost $35.00 per student, were donated by LSU for the 2011-2012 school year. In the future, I will continue to seek outside funding if our local school board does not provide it for this program. It took a few successes in the computer lab and the realization that they liked the computer time more than the textbook or worksheets for the students to settle down to work.

As with all kids, a small change in scenery, the lab as opposed to the classroom, created some initial rowdy behavior. Once the newness of moving wore off and I had the buy-in from the majority of the students, the difference between their traditional classroom work ethic and the computer lab work ethic was astounding. In the traditional setting, when they were responsible for working from a text or on a worksheet, they were more prone to chatter or doodle. On the computer, especially when they began to see the “Well Done” or “Fantastic” messages for correct answers, the silence due to concentration was unprecedented. There was still communication, as students helped each other and reminded each other how to input answers, but the “math talk” in the classroom far outweighed the “off-task” talk while students were on computers.

Each student was responsible for taking notes in class and bringing the notebook to the computer lab or having it in class when the laptops were in use. The class expectation was for each student to keep a careful journal of his work from the computer program. He was responsible for writing down the problem, his work, and any steps or notations that were important to remember for topics that proved difficult to remember. Such notations included things like definitions of terms, steps for dividing fractions, area of composite figures or formulas and diagrams. The students were encouraged to keep the same notebook, date every entry, and to use consecutive pages. Not every student took advantage of this practice, and many began to share notes or copy each other’s notes to use in class. As time went by, the students began to be more diligent about copying down notes from the board, or completing the practice problems before going to the computer lab. Equally

important, the students began to view and use their textbook as a resource. It's funny when you think about it: the students would never have taken on note-taking and using the textbook as a resource for learning without the insight that these are useful resources to "game" the computerized assignments and quizzes.

3.4 OBSERVATIONS

When we were in the classroom and the students were working on either desktop computers or laptops, the behavior was the same as in the computer lab. They sincerely appreciated that LSU had loaned us laptop computers and treated them with more respect than their textbooks ever got. The students worked diligently both in the computer lab and in the classroom in MyMathLab, but many were unable to finish the assignments in the allotted time. Due their deficiencies in math, some students took quite a lot of time and found the assignments difficult. Many students began to appreciate the usefulness of clearly written notes and organized work. As they began to care more about correctness, being able to find the information they needed or to check over their work in the instance of an "Oops, Incorrect" message became an obvious necessity. Of course, this revelation did not hit everyone at the same point in the year, or even everyone at all. However, the vast improvement in the studiousness of the group cannot be understated.

One feature that they made use of quite often, especially when a due date had passed was the "email my professor" tab. One of our procedures was that if a student wanted a due date extended, I needed to receive an email request from MyMathLab. Students especially took advantage of this as we approached a grading

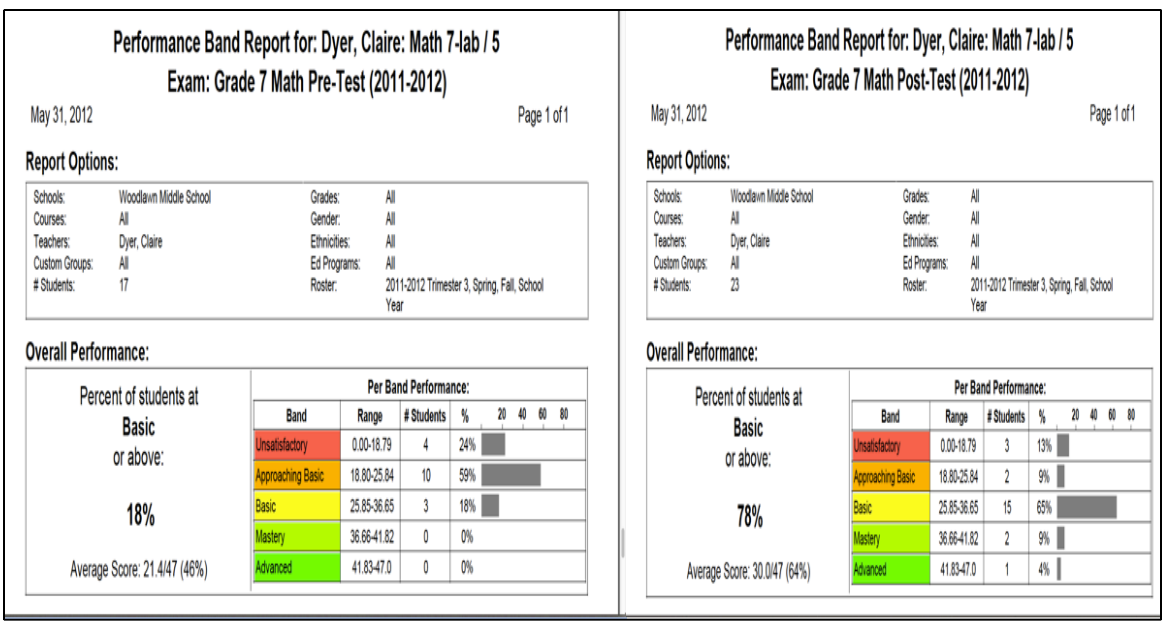
period deadline. Many students made use of the email feature when there was a question they couldn't understand or figure out and they wanted to review it in class. We found this tool to be very useful when a student was uncomfortable speaking out in class.

The focus of the lessons on the computer was to put a new face on drill and practice. Procedural fluency is a vital building block in the wall to gaining conceptual understanding, or improving it. If a student gets lost in the basic computations necessary to complete a task, frustration takes over and the opportunity for growth is lost. While only being one of the five strands of math proficiency, without procedural fluency all the other strands break down or cannot be maximized. However, as procedural fluency became less of an obstacle, we began trying to strengthen the other strands more and more: adaptive reasoning, strategic competence, conceptual understanding, and productive disposition. For my students, a very important aspect of their success or lack thereof lay in the development of a productive disposition. More to the point, beginning to see math as useful and improving their self-efficacy were mountains we began to climb and conquer as procedural fluency improved.

In MyMathLab, the students worked hard without complaining about the number of problems or how long it was taking them. In fact, quite often they would ask when a new assignment was going up, or if there were others they could do. That never happens with a worksheet.

3.5 CONCLUSION

The use of MyMathLab has been an important part of building proficiency in my students. Not all of them are reaching their potential, but if an improved work ethic, a positive attitude towards the content will help them reach their potential then MyMathLab is a great step in the right direction. Working on the computer gave my students a sense of autonomy and pride in their class environment that they did not have before we had access to the program. When we discuss the strands of mathematical proficiency along with implementation of the Common Core State Standards, building procedural fluency, which directly affects self-efficacy, is paramount. The Figure 3.5 below shows the results from the Pre- and Post-Test Assessments and the gains made using MyMathLab as a tool for improving procedural fluency.


Performance Band Report for: Dyer, Claire: Math 7-lab / 5
Exam: Grade 7 Math Pre-Test (2011-2012)
May 31, 2012
Page 1 of 1

Report Options:

Schools:	Woodlawn Middle School	Grades:	All
Courses:	All	Gender:	All
Teachers:	Dyer, Claire	Ethnicities:	All
Custom Groups:	All	Ed Programs:	All
# Students:	17	Roster:	2011-2012 Trimester 3, Spring, Fall, School Year

Overall Performance:

Percent of students at **Basic** or above:

18%

Average Score: 21.4/47 (46%)

Per Band Performance:

Band	Range	# Students	%
Unsatisfactory	0.00-18.79	4	24%
Approaching Basic	18.80-25.84	10	59%
Basic	25.85-36.65	3	18%
Mastery	36.66-41.82	0	0%
Advanced	41.83-47.0	0	0%

Performance Band Report for: Dyer, Claire: Math 7-lab / 5
Exam: Grade 7 Math Post-Test (2011-2012)
May 31, 2012
Page 1 of 1

Report Options:

Schools:	Woodlawn Middle School	Grades:	All
Courses:	All	Gender:	All
Teachers:	Dyer, Claire	Ethnicities:	All
Custom Groups:	All	Ed Programs:	All
# Students:	23	Roster:	2011-2012 Trimester 3, Spring, Fall, School Year

Overall Performance:

Percent of students at **Basic** or above:

78%

Average Score: 30.0/47 (64%)

Per Band Performance:

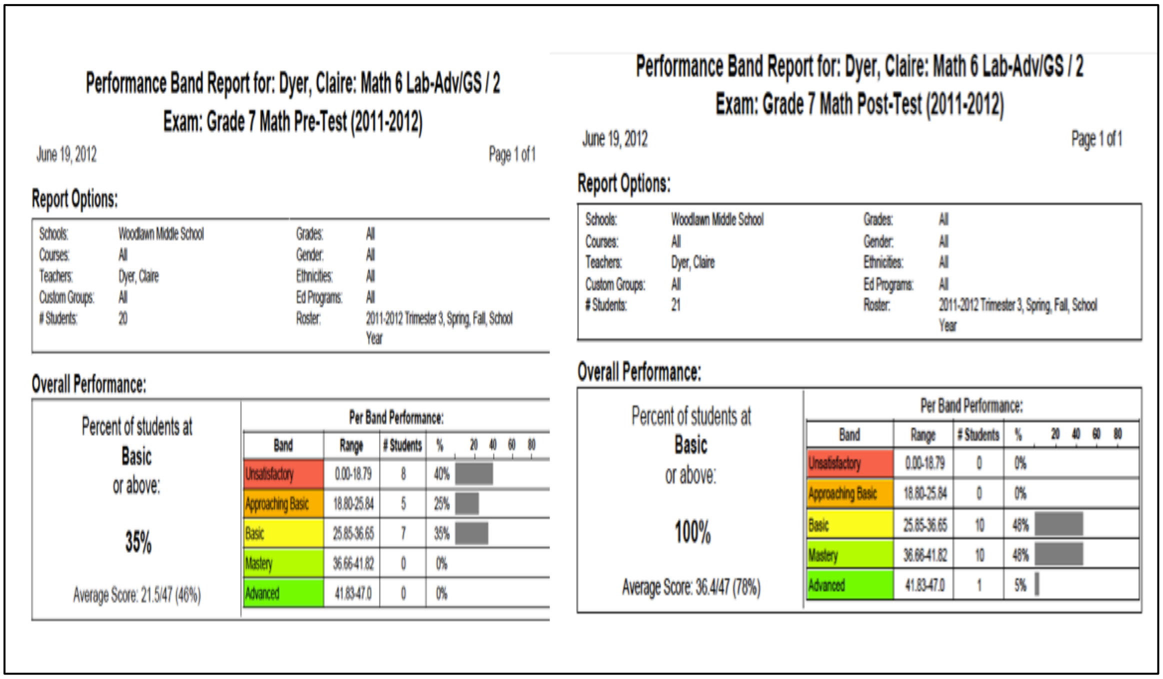
Band	Range	# Students	%
Unsatisfactory	0.00-18.79	3	13%
Approaching Basic	18.80-25.84	2	9%
Basic	25.85-36.65	15	65%
Mastery	36.66-41.82	2	9%
Advanced	41.83-47.0	1	4%

Figure 3.5: Pre-and Post Test Results

My students showed gains not only on their iLEAP (Louisiana's standardized test) scores, but also on the East Baton Rouge Parish Benchmark Assessment Post-Test for 2011-2012.

In today's classroom, often classroom management becomes an obstacle to teaching and learning. What I experienced using the computers as a learning and practicing tool was a much more manageable classroom environment. The students did not arrive in my classroom computer literate. While many students are able to navigate to game and social networking sites, the actual use of a computer as an educational tool was a new idea. They began to take their actions more seriously because they did not want to jeopardize their own computer time or the computer itself. These may seem like insignificant gains in some circles, but they were not in my classroom. The student becoming more responsible for his own surroundings, more cognizant of how his actions may affect his ability to take part in the learning process, much less be successful, is a tremendous step in the right direction.

The improvement shown by these students is remarkable given the make-up of the class and the challenges inherently involved in a class of mixed abilities. I am not suggesting that every student everywhere must have a web-based program to show improvement in math achievement. That would be a claim that I have data to prove false. Figure 3.6 shows the scores of an advanced sixth grade class that took the same Pre-and Post-test as the MyMathLab class.



Performance Band Report for: Dyer, Claire: Math 6 Lab-Adv/GS / 2
Exam: Grade 7 Math Pre-Test (2011-2012)

June 19, 2012 Page 1 of 1

Report Options:

Schools:	Woodlawn Middle School	Grades:	All
Courses:	All	Gender:	All
Teachers:	Dyer, Claire	Ethnicities:	All
Custom Groups:	All	Ed Programs:	All
# Students:	20	Roster:	2011-2012 Trimester 3, Spring, Fall, School Year

Overall Performance:

Percent of students at **Basic** or above:

35%

Average Score: 21.5/47 (46%)

Per Band Performance:

Band	Range	# Students	%
Unsatisfactory	0.00-18.79	8	40%
Approaching Basic	18.80-25.84	5	25%
Basic	25.85-36.65	7	35%
Mastery	36.66-41.82	0	0%
Advanced	41.83-47.0	0	0%

Performance Band Report for: Dyer, Claire: Math 6 Lab-Adv/GS / 2
Exam: Grade 7 Math Post-Test (2011-2012)

June 19, 2012 Page 1 of 1

Report Options:

Schools:	Woodlawn Middle School	Grades:	All
Courses:	All	Gender:	All
Teachers:	Dyer, Claire	Ethnicities:	All
Custom Groups:	All	Ed Programs:	All
# Students:	21	Roster:	2011-2012 Trimester 3, Spring, Fall, School Year

Overall Performance:

Percent of students at **Basic** or above:

100%

Average Score: 36.4/47 (78%)

Per Band Performance:

Band	Range	# Students	%
Unsatisfactory	0.00-18.79	0	0%
Approaching Basic	18.80-25.84	0	0%
Basic	25.85-36.65	10	48%
Mastery	36.66-41.82	10	48%
Advanced	41.83-47.0	1	5%

Figure 3.6: Pre-and Post Test Results for the Advanced Class

This data shows that capable students, those without the deficiencies seen in my other class can and will make gains with or without enhancements such as a web-based program. Might they make even greater gains with a program like MyMathLab? I would think so, and my hope is that in the near future all students will have access to educational technology as a fundamental part of their school day. However, at the time I set out to do this study, funding and access was a limiting factor. I chose to use the MyMathLab access I had available with the students that I felt were in the most serious need and would benefit the most from it.

It would be a mistake to focus solely on one web-based program. Pearson Education has another program, Digits, that is also a computerized math program. Unlike MyMathLab, Digits is built around the teaching environment as well as

designed for individual practice. Digits has lessons designed for interactive white boards for whole class instruction (On Level lessons), Readiness lessons that can be used to determine class readiness or as extensions for early finishers or advanced students, and Intervention lessons for the student who needs something extra. Because students have personalized study plans, the lessons can be modified individually to ensure that every student gets the instruction and practice they need. Along with the computerized assignments, Digits has another component MyMathLab does not have. Each student receives a companion booklet where he answers extended response application problems. Digits is aligned to the Common Core State Standards, so the practice generated online and in the companion booklets is tied to what is expected in the CCSS.

While I did not use Digits in my classroom these past 2 years, it is my intention to use the program for the 2012-2013 school year. I believe it will take me a step closer to finding a balance between procedural fluency and conceptual understanding. Attacking the five strands of proficiency at once seems insurmountable, but once these two are working together, the other three (productive disposition, adaptive reasoning, and strategic competence) can be woven together nicely.

CHAPTER 4: EXTENDED WRITTEN TASKS

4.1 INTRODUCTION

4.1.1 DEFINITION OF TASK

In the mathematics classroom, teachers sometimes use terms within the context of their own classroom where the teacher and students all share an understanding of the meaning, but the term may have other denotations outside their circle of understanding. Dictionary.com defines task as " a definite piece of work assigned to a person" and " a matter of considerable difficulty" (Dictionary.com). Tasks are defined by Doyle as the "products that students are expected to produce, the operations that students are expected to use to generate those products, and the resources available to students while they are generating the products" (Doyle, 1983). Robert E. Wood makes a similar statement concerning tasks, noting the three essential components being products, required acts, and information cues (Wood, 1986).

For the purposes of my class and this paper, task is defined as a complex problem involving multiple steps and layers of difficulty, depending on procedural fluency to demonstrate conceptual understanding. The solutions may include models; require abstract reasoning and perseverance to complete successfully. Umland states that some of the characteristics that we define a good task as having are easily agreed upon by educators, while others only become a shared understanding through experience writing, discussing, revising and using tasks over time (Umland, 2011).

According to Umland (Umland): All good mathematical tasks:

- Are free of mathematical errors.
- Use mathematical vocabulary and symbols accurately and appropriately.
- Only include diagrams, pictures, or illustrations that support comprehension of or provide mathematical meaning for the problem.
- Render standard mathematical representations according to the convention and with care and attentiveness to detail.
- Employ contexts in a thoughtful manner.
- Pay careful attention to units in contextual problems.
- Provided appropriate expectations for the precision of a numeric answer.
- Are clearly and concisely worded without extraneous information or detail unless one of the explicit purposes of the task is to develop or test students' ability to identify and organize relevant information (see, for example, CCSMP 1 Make sense of problems and persevere in solving them, 2 Reason abstractly and quantitatively, and 4 Model with mathematics).
- Are clearly laid out on the page with purpose and attention to detail with sufficient and well-used white space. (2011)

4.1.2 TASK INTENSITY AND DIFFERENTIATION

The intensity of a task should directly relate to the Standards for Mathematical Practices outlined in the Common Core State Standards (CCSS) as well as the grade level critical areas (domains) and strands within those areas. If the goal of the task is to assess the student's ability both conceptually and computationally, it must be structured in a manner that moves from fundamental knowledge to application and problem solving. The eight Standards for Mathematical Practices set forth in the CCSS stretch from kindergarten through 12th grade. They are:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning. (2010, p. 6)

These practices and habits naturally have different applications at each grade level, but they are common to all. If students are to be able to demonstrate secure mathematical knowledge at any given level, the tasks they are given need to have the necessary difficulty level and address as many Mathematical Practices that fit the confines of the task.

A task having the intensity necessary to challenge a student to employ the above mentioned a mathematical practice has several steps. It incorporates sections that can be solved algorithmically as well as with written responses and diagrams. It requires explanations for responses or solutions, and often asks for alternate methods for finding solutions. NCTM lists a hierarchy of task intensity based loosely on Bloom's scale of thinking order, or cognitive demands made on the student. The lowest level would be memorization tasks, progressing to procedures without connections, procedures with connections, and finally doing mathematics tasks. (NCTM, 2006) Memorization tasks are not open ended; they involve reproducing exact answers of learned facts, rules or definitions. These tasks are isolated, taken out of context from any life connection. Procedures without connections tasks are slightly more cognitively demanding in that they require the use of algorithms that

are either specifically called for or the use of one is apparent based on the needs of the task. This type of task is still explicit, with no variation called for or allowed in the “correct” answer. It has no tie to any other context or other cognitive skill. The answers do no include explanations beyond the use of an algorithm. Procedures with connections tasks require multiple representations of solutions. They require broader conceptual understanding to reach a pathway to the solution rather than a direct path to an algorithm. While multiple algorithms may be used in the solution process, they are not readily apparent at the onset. Finally, the “doing mathematics” task is a complex set of ideas that must be unraveled through exploration, trial and error, multiple representations, processes and justifications of reasoning. (NCTM, 2000) The challenge for any teacher will be to design tasks that move from the memorization level to the doing mathematics level, and to move the students along the path successfully.

Due to the individual nature of the written response sections of tasks and the accompanying explanations for solutions, a mathematical task is a valuable form of differentiating instruction and assessment. Because the student is not merely allowed to respond in his own way but is required to put his own thought process onto the page, he has the freedom to draw on his own knowledge base and experiences that help demonstrate conceptual understanding. Differentiation is a vital component of the math classroom, and allowing students the freedom to arrive at conclusions and solutions in a variety of methods contributes to the confidence level in the classroom as a whole, and in each individual student.

The following tasks were used with the primary goal of reviewing for iLEAP

and practicing constructed response answers in mind. It was not until I was involved into the project that I realized just how difficult creating a good mathematical task is. The focus here is two-fold: of course helping my students reach their potential and improve their achievement level is one, but the other is to reveal how much time, thoughtfulness, and object review of a task is necessary to ensure that it meets the standards. The ugly truth is that I was unprepared for the difficulty of my task, which was creating solid mathematical tasks for my students.

4.2 THE GRASS SEED TASK

4.2.1 INTRODUCTION

The Grass Seed Task began as a constructed response question from the East Baton Rouge Parish 2009-2010 7th Grade Benchmark Assessment, Unit 6. At the time, Unit 6 covered measurement, including converting between measures within the same system of measurement, changes in scale and changes in perimeter and area. Topics covered in previous units included area and perimeter of regular and irregular polygons, area of circumference of circles, ratio, proportions and equations. Louisiana GLE (grade level expectation) M.7.20 covers this perimeter and area of composite figures. Finding area from a scale drawing is has not been a GLE for seventh grade, and is a new addition to the CCSS for seventh grade For the 2011-2012 school year, my school adopted the scope and sequence of the state approved textbook we were use, McDougall-Littell Mathematics Course 2. All of the components of the constructed response had been taught and reviewed before my students made their first attempt.

Geometry **7.G**

Draw, construct, and describe geometrical figures and describe the relationships between them.

1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing

6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Figure 4.2.1: Common Core State Standards, Geometry Grade 7

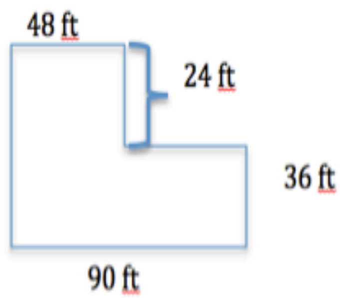
The concepts in this task are aligned to the CCSS Grade 7, the Geometry domain, strands 1 and 6 shown in Figure 4.2.1 (CCSS, p. 49).

4.2.2 ASSESSING INITIAL SKILL LEVEL

The first time the students saw the task, they were given 15 minutes to work independently. It was a participation assignment, meaning the credit assigned was given for the attempt, not for correctness. After the designated time, I projected the problem on the active board and we worked it together, sharing ideas and strategies for solving each step. When the original task is examined more closely, the students are not asked go deeply into the concept of scale drawings or reproducing a drawing at a different scale. However, even though this task does not go as far into the conceptual understanding as one would hope, it proved difficult enough for my students as is. Figure 4.2.2 shows the original task the students worked.

Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.

Below is a scale drawing of Matthew's back yard.



A. Label each side length in yards. How many yards of fencing will he need to go around the back yard.

B. The grass seed is sold in 30 lb. bags that cover 3000 square feet. How many bags should Matthew purchase?

C. At Tom's Garden Center, each 30 lb. bag costs $49.94. How much will it cost to plant the grass in the back yard? Show your work.

D. Aaron's Lawn and Garden Shop sells grass seed by the pound. One pound of seed covers 100 square feet. Each pound costs $1.45. Would it be cheaper to buy the seed at Aaron's Lawn and Garden Shop or at Tom's Garden Center? Show your work and explain your answer.

Figure 4.2.2: The Grass Seed Task

Some of the obstacles the students faced when tackling this problem included remember how to find perimeter, remembering how to change the measurements from feet to yards, labeling the side of the yard that has not already been marked,

and correctly dividing the yard into quadrilaterals they could find the area of. Since these difficulties arose in the first sections of the task, many students simply gave up on what appeared to be the more difficult sections, parts C and D. It was clear to me that some strategic instruction was needed concerning the students' approaches to the task. Not only did the students need help with their approach, I thought the task could have been structured differently so every student could have an entry point and be successful on some level.

Because this was the first time working on a task in this manner, we spent a good deal of time talking through the problem as a class. Special emphasis was placed on key words and phrases, strategies to use to remember how to do certain operations, and answering in complete sentences and showing work. During this time period, however, many students simply filled in portions of the problem they had left blank during independent work time. This is the tendency I was trying to change, which is why I felt it was important for the students to understand that this was participation for practice time, not judgment time. Not only do students tend to shrink form intimidating situations, I want to create an atmosphere in the class where the students learn enjoy the challenge and not feel the threat of a bad grade looming over their heads. The purpose of the independent time was to access the information the students had tucked away and didn't realize it. The great struggle for me was to motivate students to overcome whatever it was that kept them from writing something down on their paper, to try. For this particular task, my emphasis was on teaching the students how to answer an extended response question, so the

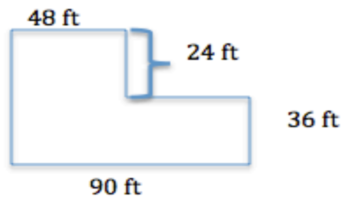
real challenge for them came when they had to answer on their own as I gave them a new version of the same task.

4.2.3 THE GRASS SEED TASK RE-VISITED

After working together on the original Grass Seed Task and identifying some of the challenging sections of the task, we discussed some strategies for beginning a task involving measurements. Some of the ideas the students had were: check all the units to see if they are what the question is asking for or if conversions are necessary; label all parts of the diagram; use mnemonic devices to help remember how to convert units if necessary; and read carefully before beginning work. The students were allowed to make a checklist before beginning the second version of the grass seed task. As with all groups of students, during this time some students began to furiously take notes and organize their information while others spent the time in unproductive ways. The challenge for me is to find a method of inviting reluctant learners into the discussion of ideas without creating too much "down time" for those already on board. One method I use that works with relative regularity is "Think, Pair, Share". After we think together as a class, then the students can partner up and work on their notes together, confirming information or generating new notes for each other. Figure 4.2.3 on the next page shows the new version of the task, restructured to not only give every student entry into the problem, but to group the components of the task in such a way that the students don't have to jump back and forth between ideas.

Constructed Response
7th Grade

Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.



A. Find the total area of Matthew's backyard. Show your work.

B. The grass seed is sold in 30 lb bags that cover 3,000 square feet each. How many bags should Matthew purchase to cover his yard with seed? Show your work and explain your answer.

C. At Tom's Garden Center, each 30 lb bag costs $49.95. How much will it cost to plant the grass seed in the back yard? Show your work.

D. Aaron's Lawn and Garden sells grass seed by the pound. One pound of seed covers 100 square feet and costs $1.45. Would it be cheaper to buy the grass seed at Aaron's or at Tom's? Show your work and explain your answer.

E. Convert the side lengths of Matthew's back yard to yards. Show your work. Be sure to label every side.

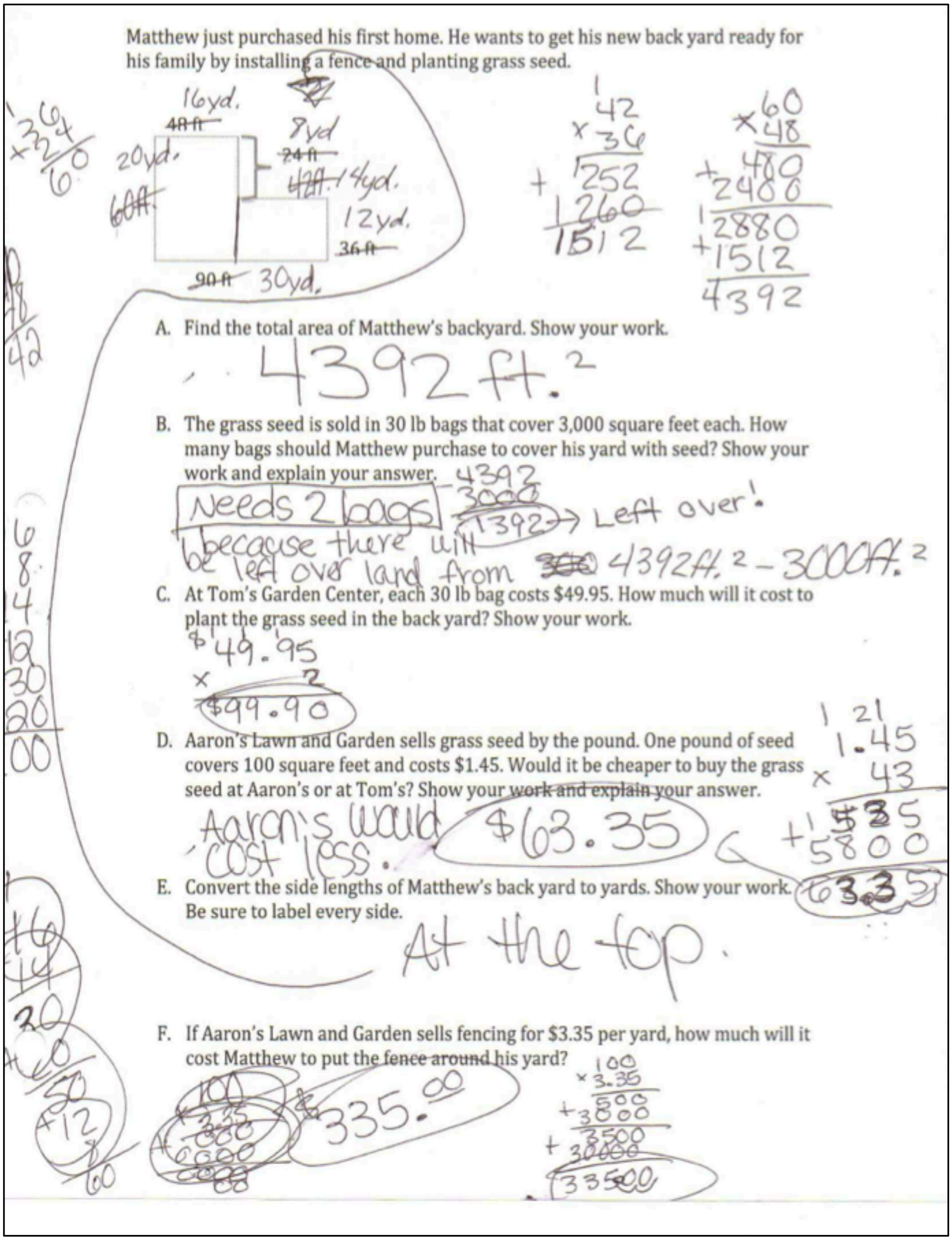
F. If Aaron's Lawn and Garden sells fencing for $3.35 per yard, how much will it cost Matthew to put the fence around his yard?

Figure 4.2.3: Grass Seed Task Extension

4.2.4 STUDENT WORK AND OBSERVATIONS

The students' work reflected more of a willingness to attempt the answers than a true understanding of the content on this task. While many were able to arrive at the correct area and perimeter of the yard, several were still unable to compute the cost at Aaron's Lawn and Garden, as it was sold by the pound and

covered a square foot amount. Keep in mind; this was after solving these same questions together as a class. Figure 4.2.4 below shows 2 examples of student work.


Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.

16yd. 48 ft 8yd 24 ft 20yd. 60ft. 42ft. 14yd. 12yd. 36 ft 90 ft 30yd.

A. Find the total area of Matthew's backyard. Show your work.

4392 ft.²

B. The grass seed is sold in 30 lb bags that cover 3,000 square feet each. How many bags should Matthew purchase to cover his yard with seed? Show your work and explain your answer.

Needs 2 bags because there will be left over land from 4392ft.² − 3000ft.²

4392 − 3000 = 1392 → Left over!

C. At Tom's Garden Center, each 30 lb bag costs $49.95. How much will it cost to plant the grass seed in the back yard? Show your work.

$49.95 × 2 = $99.90

D. Aaron's Lawn and Garden sells grass seed by the pound. One pound of seed covers 100 square feet and costs $1.45. Would it be cheaper to buy the grass seed at Aaron's or at Tom's? Show your work and explain your answer.

Aaron's would cost less. $63.35

E. Convert the side lengths of Matthew's back yard to yards. Show your work. Be sure to label every side.

At the top.

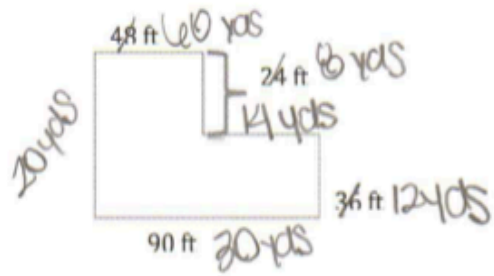
F. If Aaron's Lawn and Garden sells fencing for $3.35 per yard, how much will it cost Matthew to put the fence around his yard?

$335.00

Figure 4.2.4: Student Work, Grass Seed Task

(**Figure 4.2.4** continued)

Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.



A. Find the total area of Matthew's backyard. Show your work.

30 × 12 = 360 20 × 60 = 1200 1200 + 360 = 1560 1560 yds²

B. The grass seed is sold in 30 lb bags that cover 3,000 square feet each. How many bags should Matthew purchase to cover his yard with seed? Show your work and explain your answer.

He needs 33 bags 33 x 100 = 3300

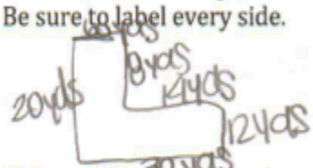
C. At Tom's Garden Center, each 30 lb bag costs $49.95. How much will it cost to plant the grass seed in the back yard? Show your work.

49.95 x 2 = 99.90 It will cost $99.90

D. Aaron's Lawn and Garden sells grass seed by the pound. One pound of seed covers 100 square feet and costs $1.45. Would it be cheaper to buy the grass seed at Aaron's or at Tom's? Show your work and explain your answer.

Aarons becaus all he needs is 2 bags 44 x 100 4360ft <4400

E. Convert the side lengths of Matthew's back yard to yards. Show your work. Be sure to label every side.



F. If Aaron's Lawn and Garden sells fencing for $3.35 per yard, how much will it cost Matthew to put the fence around his yard?

1560 yds × 3.35 = 5226 $52.26

These examples represent the average performance in the class, and illustrate some of the challenges the students face when attacking a task. Notably, organization of work, while not necessarily indicative of ability, at times impedes the student's ability to complete all parts of the task successfully. Failure to read and re-read the question before giving a final answer resulted in at least one incorrect answer, even though the work and thinking leading up to the answer was logical. It occurred to me (after seeing the results from the second version) that more relevant pre-task activities would give students a more secure background of understanding. For example, letting the students create their own composite figures to find areas would likely create a personal interest that would generate an association. Conceptual understanding cannot be the sole outcome by which we measure success on these tasks. Educators seek to promote life-long learning habits, self-efficacy based on internal drives and motivations, and content knowledge in our students. Tasks that are approachable, enjoyable, and that promote math dialog in the classroom provide a platform for teachers to build on. Understanding that the goal of school boards and governing bodies is to enhance or build conceptual understanding that can be measured, the foundational experiences really need to be experiences, not just practice work with no real-life connection.

4.2.5 CONCLUSION AND FURTHER EXTENSION

The students did not perform as well as I had hoped on the Grass Seed Task, even though we worked through it together with what I thought was a more difficult arrangement of the questions. Given the difficulty students have with measurement

across the grade levels and achievement levels, measurement tasks should be a recurring theme in any teacher's archive of lessons. Because measurement can be adapted to such a wide variety of situations, it can be woven into the curriculum at almost any given time. Reviewing and recycling content should be part of every classroom strategy. Finding the area of a composite figure or regular polygons, calculating perimeter, converting units of measure within a system of measurement are difficult procedures for students to remember without constantly doing them. Vocabulary is a hindrance for many students, so generating a classroom glossary in the form of a word wall with accompanying diagrams, one that is student made and maintained is a important tool in creating a print-rich, comfortable learning environment. Another aspect of generating a habit of thinking and writing during while finding solutions to tasks would be the structuring of the task document. The tasks worksheets I used did not offer enough space for pre-solution work, laying out ideas and writing an explanation of a final answer. Clearly, if I had been able to use the characteristics of a good math task as outlined by Umland (2011) as a guide, some of these issues would not have existed. I believe it emphasizes the need for teachers to not work in isolation, for professional development to be content centered, and for continued collaboration elementary, middle and high schools with each other as well as with higher institutions of learning such as Louisiana State University.

An example of another extension that fits well with this task or could stand-alone as a task in itself is called Plant the Park. In this more complex and highly rigorous task the students are asked to go deep into the geometry strand and utilize

critical thinking, adaptive reasoning, and modeling to come up with solutions. Part of the task involves estimating area, and the students must design an estimation technique. This section alone involves a high degree of planning and strategy, far more than the original task questions. Not only would the new task require an understanding of area, it involves creating a scale to find area from related lengths of surrounding items. The rigorous nature of this creative process takes this task to an entirely new level of difficulty. From this task, a teacher could develop a single unit or many units covering several relevant experiences such as: landscaping, budgeting, horticulture and parks and recreation. These platforms give context to the math involved and invite students into a world beyond the classroom. Figure 4.2.5 is a sample of the Plant the Park extension task. The picture is an aerial view of our school from www.googlearth.com.

Figure 4.2.5: Plant the Park Extension

(**Figure 4.2.5** continued)

The picture above shows the walking path and Community Park at Woodlawn Middle School.

Our problem: We need to purchase grass seed to cover the area inside the walking path and concrete to pave the sidewalk.

A. How would you estimate the area of the sidewalk to be paved?

B. How would you determine the area of the field? Keep in mind you are looking at an aerial shot of the park. See what you can determine using what you know about the objects visible to you in the photo. Be as descriptive as possible in your explanation, using diagrams if necessary.

C. How crucial is it for your measuring technique to give you reasonable results? Would it make a difference if you were over or under in your estimation? How big of a difference? What determines if the estimate is close enough? Explain your answer fully, giving examples for your reasoning

D. Find the approximate area of the field we are planting.

I was unable to complete this task with my students this year, but it will be a part of my class activities for the 2012-2013 school year. I am interested to see how the different level classes that I teach approach the same problem. The "math talk" that takes place among the students and the methods they determine are appropriate to estimate area of an irregular space as large as our Community Park should prove to be educational for all of us.

4.3 THE BETTER BUY TASK

4.3.1 Introduction

Seventh grade math teachers at Woodlawn Middle School originally wrote the Better Buy Task for submission to the Mathematics Instructional Management Team for East Baton Rouge Parish. Its intended purpose was to go into a bank of practice constructed response questions for parish wide use. This constructed response question was subsequently used in my classroom for just such practice. At the time it was written, it fit within the guidelines of East Baton Rouge Parish's Louisiana Comprehensive Curriculum Grade 7, Unit 3. Louisiana GLE M.7.10 states that students will determine and apply rates and ratios. It is aligned with the Common Core State Standards, Grade 7.RP.1 and 7.RP.2.c (ratios and proportional relationships domain, strands 1 and 2 part b). Figure 4.3.1 shows both strands. (CCSS, p.48)

Ratios and Proportional Relationships **7.RP**

Analyze proportional relationships and use them to solve real-world and mathematical problems.

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction* $^{1/2}/_{1/4}$ *miles per hour, equivalently 2 miles per hour.*
2. Recognize and represent proportional relationships between quantities.
    a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
    b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
    c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.*
    d. Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r*) where *r* is the unit rate.

Figure 4.3.1 Common Core State Standards, Ratios and Proportions, Grade 7

This task followed extensive work in class involving ratios and proportions of all varieties. The students had experience with map scales, similar figures, indirect measurement, unit rates and the percent proportion. Those problems came from the textbook and other worksheets. The lessons including finding a side measure of similar triangles and quadrilaterals, finding actual or scale measurements using map scales, finding the height or length of an object or its shadow using known height and length of a similar object, and unit rates using topics such as miles per hour and price per pound. For this task, the students were able to use a calculator to avoid non-entry into the task due to non-fluency in basic arithmetic. These problems were taught in the context of solving proportions, not as tasks oriented lessons. The focus was on the procedure and the ability to recognize a rate when given one in a word problem.

4.3.2 ASSESSING INITIAL SKILL LEVEL

By the time I assigned the Best Buy Task, we were in full iLEAP review mode. Not only had the students been given instruction and assessment on the concepts during the school year, they were seeing a good bit of the material for the second or third time. Prior to attempting this task the students had looked at grocery ad flyers and found unit rates of items seen there. The task in its original form called for a comparison of two brands of salsa to find the best buy. Figure 4.3.2 shows the original task.

Constructed Response
7th Grade

A+ Grocery sells a 12.5- ounce of Spicy Time salsa for $2.89. They sell an 8-ounce jar of Southwest salsa for $1.75.

1. Find the unit rate for each jar of salsa.

2. Which jar is the better buy? Explain your answer.

3. On Tuesday, there was a coupon for 40 cents off the price of the Spicy Time jar of salsa.
   A) What is the new unit rate, after the discount?
   B) What is the difference of the unit rate of the Spicy Time jar of salsa before and after the discount of 40 cents?

Figure 4.3.2: Best Buy Task Original

Very few students, at this point in the year had difficulty find the unit rate for each jar of salsa in terms of the process. What they did have trouble remembering was how to deal with a 4-digit decimal answer when the subject was money. The most common mistake was to simply drop off every number to the right of the hundredths place, with little regard for rounding in either direction. It is important to include a discussion here concerning unit rates, as they pertain to money, with students. It is customary in the middle school curriculum that I use to round unit rates concerning money to the nearest cent, or penny. However, quite often the correct unit rate does not result in an even penny, and such is the case in the problem above. This leads to very practical discussions and thought provoking task extensions in the classroom. It opens the door for explorations into the effects of rounding unit prices, correctly or incorrectly, on the consumer or the seller of a

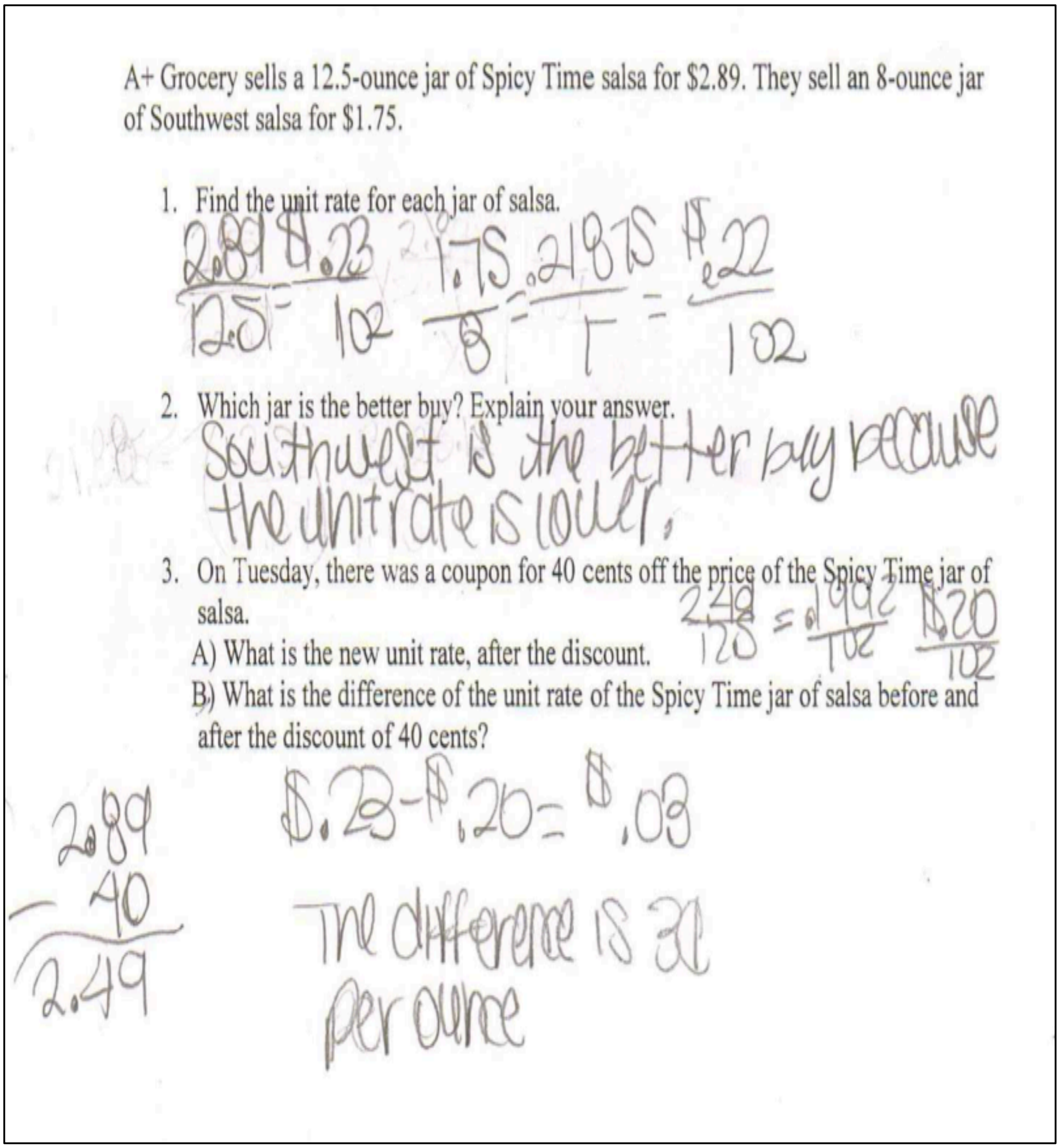
product. While there is evidence in the problem above that the students are aware of the "extra" decimals in the unit rate, they are not given any opportunity to reflect on the effects of rounding to the nearest cent. An opportunity to examine attending to precision in a practical application of price when a unit rate is rounded is missed in this task.

Another area of weakness was Mathematical Practice 6 from the CCSS, Attend to Precision. It became obvious to me that I had not been diligent in holding the students accountable for identifying units of measure, either in the course of the problem or in the answer. As with the previous task, attention to detail and completeness of verbal explanation of the answer emerged as an area needing improvement. While the initial ability on this task exceeded by a wide margin the first attempt on the Grass Seed Task, there were still many opportunities for growth.

4.3.3 STUDENT WORK AND OBSERVATIONS

Answering the questions on this task did not prove to be as challenging as I thought it was going to be for my students. In fact, their recall of unit rates concerning money surprised me. What I did notice though, was the mistakes made when came to rounding the unit rate to the nearest cent and answering Part b on Question 3. In terms of rounding to the nearest cent, however, the students who wrote the full decimal answer first were more likely to pay attention to rounding correctly. The students who simply punched the numbers into the calculator and glanced at the display to find the two numbers to the right of the decimal were more likely to ignore the rounding aspect. Moreover, in answering Question 3, the

students were able to find the new unit rate without much difficulty. The errors came when they were in too much of a rush to be finished, and did not go back to make sure they answered the right question for Part b. Figure 4.3.3 shows 2 examples of student work on this task.


A+ Grocery sells a 12.5-ounce jar of Spicy Time salsa for $2.89. They sell an 8-ounce jar of Southwest salsa for $1.75.

1. Find the unit rate for each jar of salsa.

$\frac{2.89}{12.5} = \frac{\$.23}{1oz}$ $\frac{1.75}{8} = \frac{.21875}{1} = \frac{\$.22}{1oz}$

2. Which jar is the better buy? Explain your answer.

Southwest is the better buy because the unit rate is lower.

3. On Tuesday, there was a coupon for 40 cents off the price of the Spicy Time jar of salsa.

A) What is the new unit rate, after the discount.

$\frac{2.49}{12.5} = \frac{.1992}{1oz}$ $\frac{\$.20}{1oz}$

B) What is the difference of the unit rate of the Spicy Time jar of salsa before and after the discount of 40 cents?

$2.89 - .40 = 2.49$

$.23 - $.20 = $.03

The difference is 3¢ per ounce

Figure 4.3.3: Examples of Student Work, Best Buy Task

(**Figure 4.3.3** continued)

A+ Grocery sells a 12.5-ounce jar of Spicy Time salsa for \$2.89. They sell an 8-ounce jar of Southwest salsa for \$1.75.

1. Find the unit rate for each jar of salsa.

$\frac{\$2.89}{12.5 \text{ ounce}} = \frac{\$.23¢}{1 \text{ ounce}}$ $\frac{\$1.75}{8 \text{ ounce}} = \frac{22¢}{1 \text{ ounce}}$

2. Which jar is the better buy? Explain your answer.

Southwest salsa bc its cheaper

3. On Tuesday, there was a coupon for 40 cents off the price of the Spicy Time jar of salsa.
   A) What is the new unit rate, after the discount.
   B) What is the difference of the unit rate of the Spicy Time jar of salsa before and after the discount of 40 cents?

A. $2.89 - .40 = 2.49$ $\frac{2.49}{12.5} = \frac{19¢}{1}$

B. Spicy time was more money and after the discount is cheaper than the other brand.

$\frac{19¢}{1 \text{ ounce}}$ $\frac{22¢}{1 \text{ ounce}}$ 3¢ difference.

Again, the challenge in tasks of this nature is not that they are cognitively difficult at the end of the year. The students did not give any indication that they could not recall procedures or understand the concept. The challenge is making sure there are habits in place that compel the students to demonstrate practices of proficient math students. These habits are built over the course of a student's early educational career, and must be diligently practiced at every grade level, with increasing rigor and intensity. Attending to precision, constructing viable arguments and making sense of the problem and persevering in solving it would have helped many

students eliminate the careless error of not answering the correct question in Part b of Question 3.

4.3.4 EXTENSION OF THE TASK AND INCREASING THE RIGOR

Since the issues the students were having with this particular task were not comprehension oriented, the alterations I made to the task were extensions to add some relevance to the context of the problem. Many students have difficulty transferring their life knowledge to the classroom and vice versa. For example, when finding a sale price in class, many students cannot remember whether to add or subtract the discount. When taught in isolation, the skills are meaningless to students who have difficulty making connections. To give some true texture to the task, where finding the better buy was crucial to the decision-making, I created the extension Picnic Time. Figure 4.3.4 shows the extension task that would give meaning to the unit rates and best buy choices instead of working a problem outside of any context of actually making a purchase. The focus of the task, especially if worked with a partner, would be to generate a conversation of decision making and planning. This aspect of "math talk" is not always apparent to students, but can have a profound impact on shaping their thinking patterns and broadening their perspectives. Students generating associations and creating thinking habits while talking with their peers will also impact their attitude towards a task, affecting their self-efficacy. Additionally, having to work within a budget puts finding the best buy in a light not addressed in the original problem.

Picnic Time

You are helping to plan a picnic for a family reunion. Your job is to find the best prices for the main part of the meal, the beef, pork or poultry to be cooked on the grill. From the ads above, you must find the most economical way to feed 45 people with a combination of beef, poultry or pork.

1. How would you determine how much of each type of food to buy? Make sure you are specific in your answer and include any diagram you need to explain yourself.

2. Once you decide what to buy, what steps would you take to determine where to buy it? What things do you need to think about before you make your purchase?

3. Suppose there is a budget of $7.00 per person for the entire cost of the meal. How do you plan your purchase of the main course? What other parts of the meal must be considered? Make a list of everything that needs to be purchased to prepare a meal like this. What is the total cost for the meal and all its components for this reunion? ***Keep in mind it's a picnic.

4. Where do you plan to buy the beef, chicken and poultry? Will it all be from the same store? Use the ads on these pages to make your decision.

Figure 4.3.4: Best Buy Task Extension

The better buy task extension, Picnic Time, involves more than just the calculations for the best buys on food. It also requires the students to create a record-keeping tool and to provide clear descriptions as to how they came to their conclusions.

4.3.5 CONCLUSION

I did not get a chance to use the Picnic Time extension this year with my students. However, with the new awareness I have of the CCSS and the attention given to reasoning, being able to justify and answer verbally or using diagrams or charts, my future students will certainly have the opportunity to fully develop their understanding of rate as it relates to money and budget. A further extension of the task would include actually having a class picnic. Nothing would secure the conceptual understanding of the “better buy” idea more than the students using their own class money to buy their own food. Yet another example of an extension is a cost comparison of driving out of state on vacation as opposed to taking the bus or flying. While time consuming and planning intensive, these are the association building events that build true conceptual understanding and enhance a positive classroom environment. The necessity of being able to transfer an algorithmic skill from the classroom to real life conceptual understanding cannot be understated. Equally, educators cannot fail to realize that many students do not make those connections without our concerted effort to provide exposure.

4.4 THE PROBABILITY TASK

4.4.1 INTRODUCTION

The Probability Task was taken from material used at Woodlawn Middle School for LEAP review for eighth graders. Because simple probability using tree diagrams and compound events is also part of the seventh grade curriculum, I felt it was appropriate to use in my class as well. While most students have a high degree of confidence concerning their understanding of probability, once the shift is made from simple probability to almost anything else, their understanding breaks down. Probability is also part of the Common Core State Standards (CCSS) for seventh grade, and this particular task aligns to CCSS 7.SP.8. Figure 4.4.1 shows the strand. (CCSS, p. 51)

Statistics and Probability **7.SP**

8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
   a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
   b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
   c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

Figure 4.4.1: Common Core State Standards, Statistics and Probability, Grade 7

Theoretical and experimental probability have typically shown up in the Grade 7 Louisiana Comprehensive Curriculum in Unit 7, although simple probability is touched on earlier in the year. By the time the students are expected to make comparisons between experimental and theoretical outcomes they have been exposed to percent, ratio, and fraction comparisons.

4.4.2 ASSESSING INITIAL SKILL LEVEL

The task, in its original form, was very straightforward and the students were not asked to answer any critical thinking questions. The first two parts of the problem could be answered numerically, with no indication given as to how the student arrived at the answer, much less any insight given to the thought process used to determine if the answer was correct. My students responded with varying degrees of thoughtfulness. Some, as one would expect, brought all of their ability to bear but invariably overlooked some crucial steps that would have lead to the correct answer. Others spent very little time pondering the possibilities and wrote down the first answer that occurred to them and moved on to the next question, sometimes finishing in the amount of time it took to read the question. Naturally, when the students were not asked for anything more than a numerical answer, the students that were thankful for any number occurring to them wrote it down and moved on. Unfortunately for me, without verbal questioning that is often intimidating for a struggling student, there was no practical way to go back and reconfigure the thought process. While it is evident that the students had an entry-

level knowledge of probability, the answers, though correct, do not give any insight into student understanding. Extending the written task and requiring more input from the student is one way to get at those thoughts and uncover deficiencies or misconceptions. Figure 4.4.2 shows two examples of student work on the task in its original form.

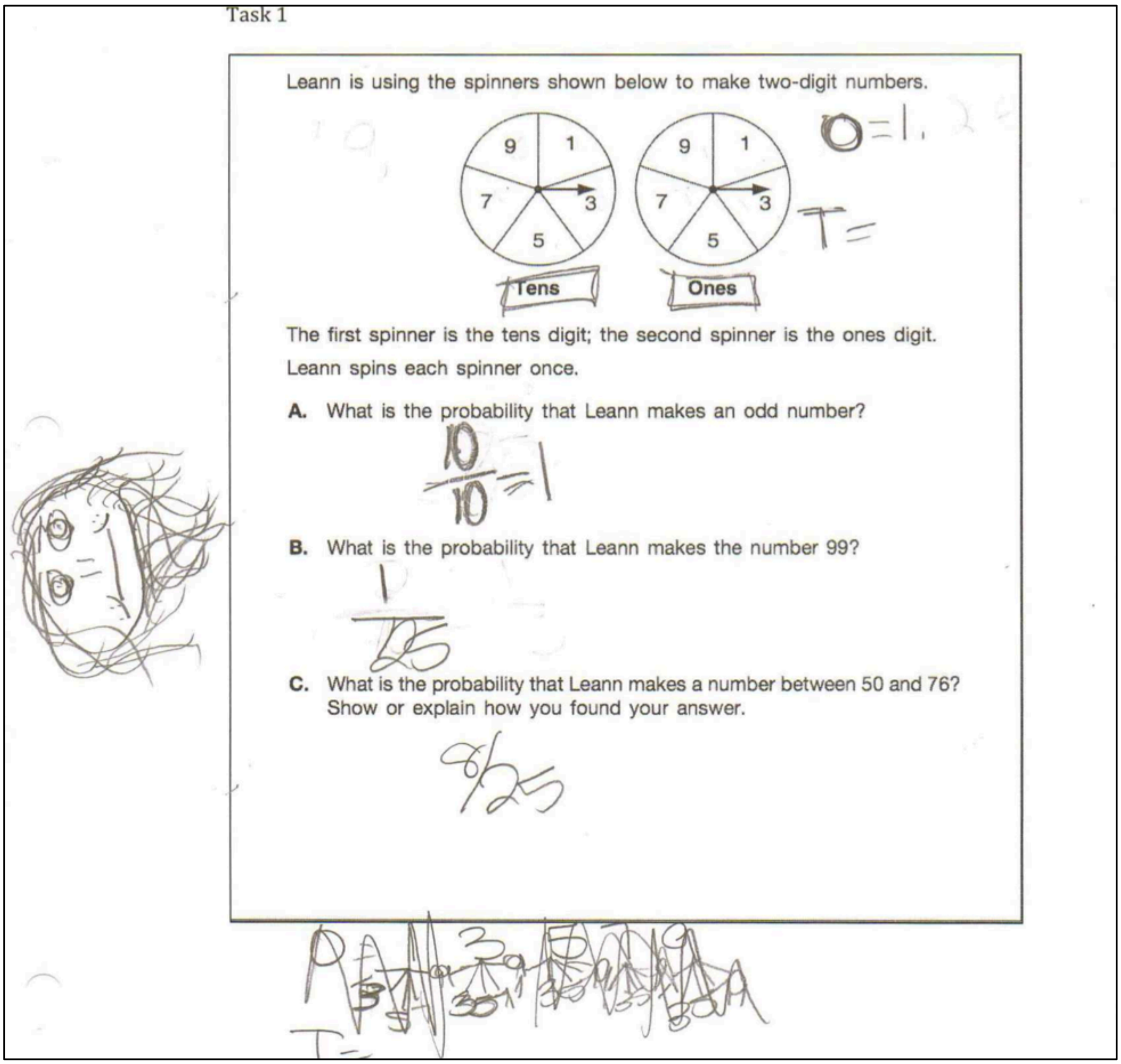
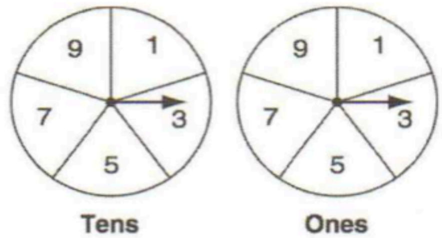


Figure 4.4.2: Student Work, The Spinner Task Original

(**Figure 4.4.2** continued)

Task 1

Leann is using the spinners shown below to make two-digit numbers.



The first spinner is the tens digit; the second spinner is the ones digit.
Leann spins each spinner once.

A. What is the probability that Leann makes an odd number?

25

B. What is the probability that Leann makes the number 99?

1/25

C. What is the probability that Leann makes a number between 50 and 76?
Show or explain how you found your answer.

8/25

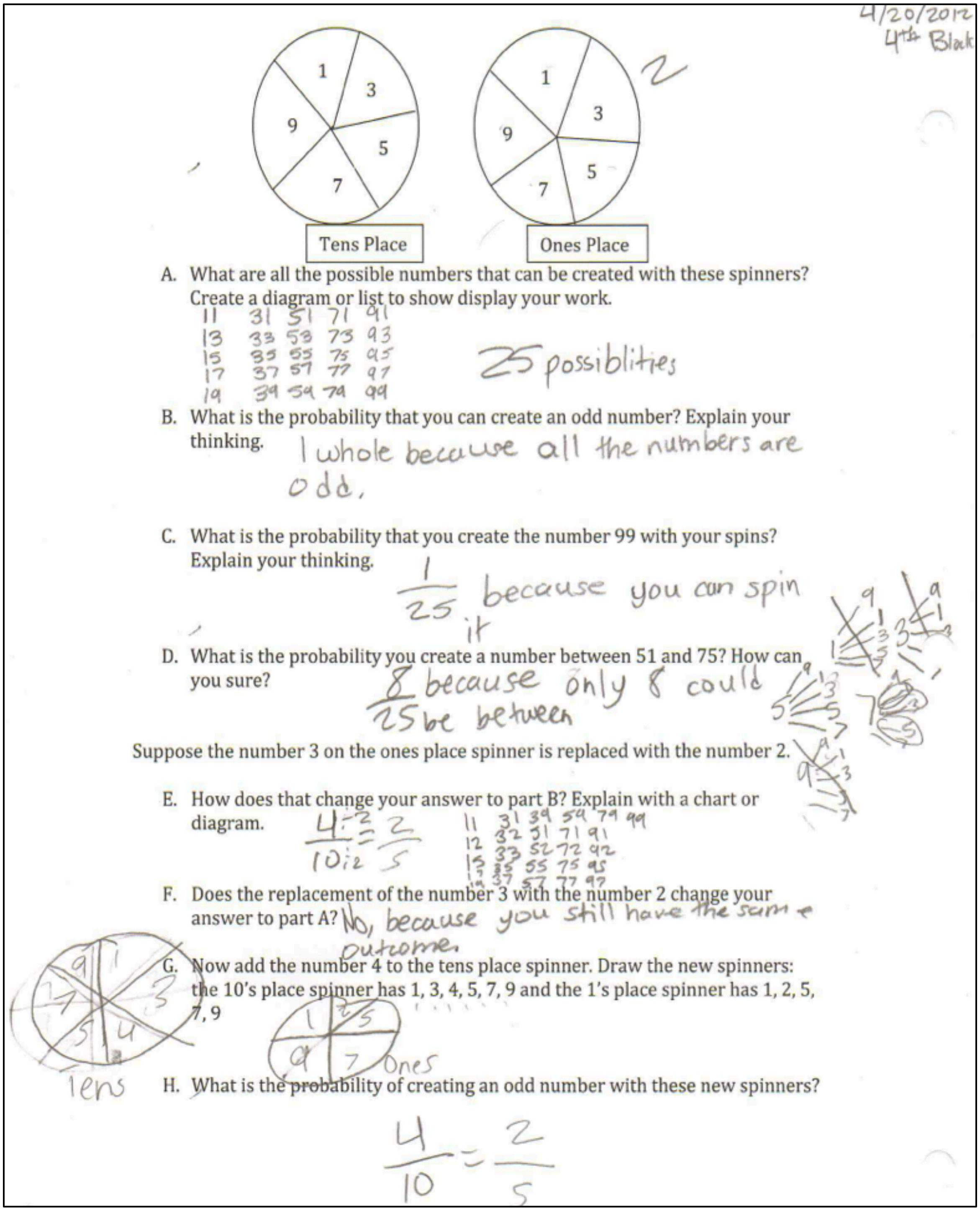
As seen in the student work above, there are "task" questions that do not reflect the rigor or thought provoking intensity we are expecting from our students. The students can answer correctly enough for the specific questions, but can they go

beyond with their reasoning? That is the gap I am trying to bridge with ever increasing intensity in my tasks.

4.4.3 EXTENSION OF THE TASK AND INCREASING THE RIGOR

To extend the time students spent thinking about the situation presented in the task, I added some additional requirements to it and altered some of the sections. The students were asked to actually write out their thinking in terms of a chart or diagram instead of simply answering in numerical form. My hope was that if they spent time organizing their thoughts at the beginning of the task, they would be more likely to spend time using their own work to answer other parts of the task. Changing parts of the initial diagram mid-task increased the rigor and intensity of the task. Students then had to contemplate how the addition of new information would affect their previous answers. This added a dimension of complexity to the problem that did not exist before. I was hoping the students would take more time on these answers, creating and then referring the charts or lists to arrive at their solutions. Another improvement I was looking for was evidence the students were critical of their own work by. I looked for this evidence in part F of the revised task, which I thought would tell me if they read the question carefully and then compared their answers with a critical eye. One of the biggest obstacles middle school and probably all students face is developing diligent work habits. The tendency to move away from an item as soon as an answer has been written is a difficult one to break, especially if the student is already apprehensive about his work. Checking one's work opens up the possibility that a mistake might be discovered, in which case the

process starts all over again. Figure 4.4.3 shows two examples of students' work from the revised spinner task.



4/20/2012
4th Block

Tens Place

Ones Place

A. What are all the possible numbers that can be created with these spinners? Create a diagram or list to show display your work.

11 31 51 71 91
13 33 53 73 93
15 35 55 75 95
17 37 57 77 97
19 39 59 79 99

25 possiblities

B. What is the probability that you can create an odd number? Explain your thinking. 1 whole because all the numbers are odd.

C. What is the probability that you create the number 99 with your spins? Explain your thinking. $\frac{1}{25}$ because you can spin it

D. What is the probability you create a number between 51 and 75? How can you sure? $\frac{8}{25}$ because only 8 could be between

Suppose the number 3 on the ones place spinner is replaced with the number 2.

E. How does that change your answer to part B? Explain with a chart or diagram. $\frac{4}{10} \div 2 = \frac{2}{5}$

F. Does the replacement of the number 3 with the number 2 change your answer to part A? No, because you still have the same outcome.

G. Now add the number 4 to the tens place spinner. Draw the new spinners: the 10's place spinner has 1, 3, 4, 5, 7, 9 and the 1's place spinner has 1, 2, 5, 7, 9

Tens

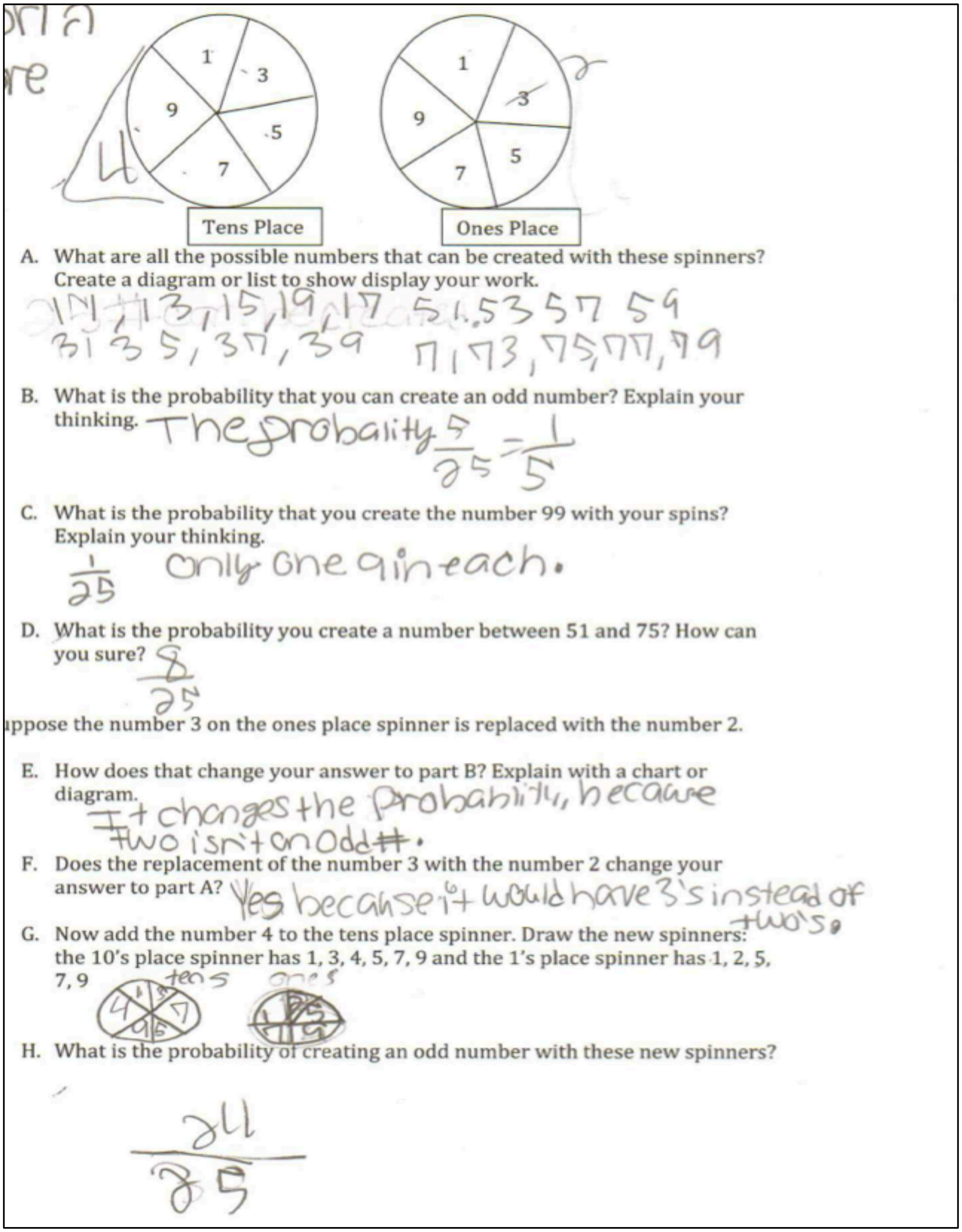
Ones

H. What is the probability of creating an odd number with these new spinners?

$\frac{4}{10} = \frac{2}{5}$

Figure 4.4.3: Examples of Student Work, The Spinner Task

(**Figure 4.4.3** continued)



Tens Place

Ones Place

A. What are all the possible numbers that can be created with these spinners? Create a diagram or list to show display your work.

11, 13, 15, 19, 17 51, 53 57 59
31 35, 37, 39 71, 73, 75, 77, 79

B. What is the probability that you can create an odd number? Explain your thinking. The probality $\frac{5}{25} = \frac{1}{5}$

C. What is the probability that you create the number 99 with your spins? Explain your thinking.

$\frac{1}{25}$ only one 9 in each.

D. What is the probability you create a number between 51 and 75? How can you sure? $\frac{8}{25}$

ppose the number 3 on the ones place spinner is replaced with the number 2.

E. How does that change your answer to part B? Explain with a chart or diagram. It changes the Probability, because two isn't an odd #.

F. Does the replacement of the number 3 with the number 2 change your answer to part A? Yes becanse it would have 3's instead of two's.

G. Now add the number 4 to the tens place spinner. Draw the new spinners: the 10's place spinner has 1, 3, 4, 5, 7, 9 and the 1's place spinner has 1, 2, 5, 7, 9 tens ones

H. What is the probability of creating an odd number with these new spinners?

$\frac{24}{25}$

4.4.4 CONCLUSION

While the addition of the new requirements increased the instances of correct responses, I was surprised to see that on the new questions the students displayed a reluctance to use their work to guide their answers. For example, in the new portion of the task, where the 3 on the “Ones” spinner is replace with a 2, the students were able to create a new table listing the new outcomes but still answered the question incorrectly. These types of results are puzzling to me, but I believe that building connections to the tasks will help the students take more care with their answers. Of course, building associations for students to draw on is only one phase of the work to be done. In the future, I must spend more time developing good habits as concerns answering questions and using words to explain thinking. One aspect that I would change on this task is the format. The layout of the questions was such that the students did not have room for a full expression of their thoughts. Secondly, in addition to changing the actual numbers on the spinners, I would add additional spinners for labeled hundreds and thousands. The addition of the extra spinners and the additional number of outcomes would hopefully prompt the students to look for other connections and patterns and not rely on making a chart or a table. This is the kind of reasoning that is very difficult teach, but exposure to tasks of this nature give experiences for the students to draw on to make the necessary mental adjustments. These are just a few examples of further extending the lesson. For my class, this was a good introductory task, both for me and for the students. It challenged them, and gave me a chance to see my shortcomings in task writing and how to improve upon them in the future.

Probability games and activities abound, but the difficult part about teaching the conceptual aspect, the math, is overcoming the seemingly ingrained superstition concerning the subject. My students can look at a spinner and determine what color is most likely to be landed on, or if the outcomes are equally likely. They have an intuitive understanding of simple dependent and independent events. For example, if there is only one red Laffy Taffy, they understand that the first person to choose the candy has the advantage. Yet, when it comes to a game or predicting what will happen next they forget what they know and make irrational decisions or guesses. I haven't quite figured out how to win that battle. In the appendix there are a few items from http://www.rbdil.org/counting.html, a webpage from the Rutgers School of Graduate Education dedicated specifically to probability. These activities could be used as introductory sets, or modified and extended meet the rigor and intensity required embedded in the new standards. To develop mathematical proficiency in this domain, the students must have enough to exposure to successes and failures concerning probability to help them expand their own reasoning for why things do or do not happen, mathematically. They also need to have enough experience with complex probability problems to develop their own construct finding a solution.

4.5 CONCLUSION

Creating a task oriented classroom where students are actively engaged in relevant, high-interest activities developing a full mental toolkit of secure knowledge is an art form I have not fully mastered. However, the tasks I

implemented this year, a sample of which are in this paper, did stretch my students thinking and fostered a sense of usability concerning their own math knowledge. There are aspects of generating a worthwhile task, one that invites students into the learning process only to ensnare them in an engaging exploration of math, which I did not fully consider at the outset. One improvement I will definitely include next year is a checklist for my students to use every time they are expected to write a verbal answer. Figure 4.5 shows one such checklist created by Yvonne Chimwaza for her Geometry students. (Chimwaza, 2012)

Journal Questions

Question:
Audience:

1. What is this problem asking you to do?
2. What steps/information will be needed to solve the problem?
3. Solve and explain your method of solving the problem.
4. How can you relate this to the real world?
5. What tools would have been helpful in solving this problem and why?
6. How can you be more precise in your explanation, if possible?
7. What patterns do you observe, if any?
8. What conjectures can you make about possible shortcuts to solving a problem like this?

Figure 4.5: Journal Questions

She matched each one of the journal questions to the eight Standards for Mathematical Practices in the Common Core State Standards. I believe these questions could be used at every grade level to guide our students into proficiency in writing. Another tool I will use next year is the list of characteristics found in a good math task, listed earlier in the chapter. These are just a few of the changes I

intend to make next year when implementing the Common Core State Standards. However, I know that the best tasks will come from a collaborative process involving teachers and mathematicians to ensure that our students get the best insight from both sides of the table, so to speak.

My students are at the beginning of this process as well, and their improvement in completing the tasks was satisfactory to me in terms of the big picture. The benchmark assessment Post-test scores indicate that there is still work to be done, and there is quite a bit of room for improvement, however, the change from the beginning of the year to the end shows that learning did take place. They are not math proficient yet, but they made definite gains as evidenced by their iLEAP scores, which is reflected in the STAR report value-added score numbers. In fact, according to the STAR rating (p.5) they not only reached their growth target but exceeded it. Every teacher wants to see such improvement, and I believe tasks play an important role in making it happen.

CHAPTER 5: CONCLUDING THOUGHTS

Combining extended written tasks with MyMathLab to increase the achievement levels of the students in my class this year was a tremendous success. Not a complete success, I still have much to learn concerning writing worthwhile tasks and implementing the Common Core State Standards and all that they encompass. I believe one outgrowth of this thesis will be considerable time devoted to professional development concerning writing a mathematically intense task that my student population can be successful with. However, putting tools in the hands of my students that help them develop confidence in their own ability, a positive attitude towards the subject of math, and an appreciation for knowing and understanding math concepts removes one of the biggest obstacles math teachers face. I believe I took a giant step forward in doing this for my students with the combination of giving them their own computer to use in class and allowing more time for peer and class discussion while working on tasks. Students entering the math classroom several grade levels behind in terms of their knowledge base, not necessarily their age, have a natural aversion to taking a risk in math. However, with the ability to differentiate the lessons in an individual web-based program, to free up class time for "math talk" while working on tasks, to have the ability to write tasks that gives students an avenue into the learning creates a comfortable environment that becomes less threatening and more effective.

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APPENDIX A: PROBABILITY INTRODUCTORY OR EXTENSION TASKS

A.1 THE PROBLEM OF POINTS

Pascal and Fermat are sitting in a cafe in Paris and decide to play a game of flipping a coin. If the coin comes up heads, Fermat gets a point. If it comes up tails, Pascal gets a point. The first to get ten points wins. They each ante up fifty francs, making the total pot worth one hundred francs. They are, of course, playing "winner takes all." But then a strange thing happens. Fermat is winning, 8 points to 7, when he receives an urgent message that his child is sick and he must rush to his home in Toulouse. The carriage man who delivered the message offers to take him, but only if they leave immediately. Of course, Pascal understands, but later, in correspondence, the problem arises: how should the 100 Francs be divided? Justify your solution.

A.2 THE WORLD SERIES PROBLEM

In a World Series, two teams play each other in at least four and at most seven games. The first team to win four games is the winner of the World Series. Assuming that the teams are equally matched, what is the probability that a World Series will be won: (a) in four games? In five games? In six games? In seven games?

A.3 A PYRAMIDAL DICE GAME

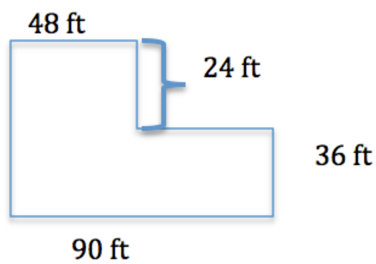
A pyramidal die has four sides, numbered 1 through 4. The number that is rolled is shown upright. Roll two pyramidal dice. If the sum of the two dice is 2, 3, 7, or 8, Player A gets one point (and player B gets 0). If the sum is 4, 5, or 6, Player B

gets one point (and Player A gets 0). Continue rolling the dice. The first person to get ten points is the winner. Is this a fair game? Why or why not? Play the game with a partner. Do the results of playing the game support your answer? Explain. (3) If you think the game is unfair, how could you change it so that it would be fair?

APPENDIX B: THE ORIGINAL GRASS SEED TASK

Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.

Below is a scale drawing of Matthew's back yard.



A. Label each side length in yards. How many yards of fencing will he need to go around the back yard?

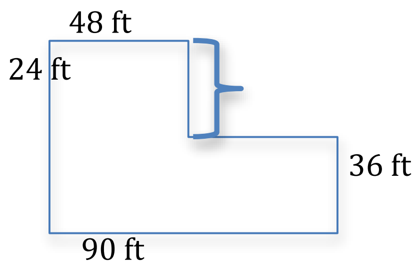
B. The grass seed is sold in 30 lb. bags that cover 3000 square feet. How many bags should Matthew purchase?

C. At Tom's Garden Center, each 30 lb. bag costs $49.94. How much will it cost to plant the grass in the back yard? Show your work.

D. Aaron's Lawn and Garden Shop sells grass seed by the pound. One pound of seed covers 100 square feet. Each pound costs $1.45. Would it be cheaper to buy the seed at Aaron's Lawn and Garden Shop or at Tom's Garden Center? Show your work and explain your answer.

APPENDIX C: THE REVISED GRASS SEED TASK

Matthew just purchased his first home. He wants to get his new back yard ready for his family by installing a fence and planting grass seed.



A. Find the total area of Matthew's backyard. Show your work.

B. The grass seed is sold in 30 lb bags that cover 3,000 square feet each. How many bags should Matthew purchase to cover his yard with seed? Show your work and explain your answer.

C. At Tom's Garden Center, each 30 lb bag costs $49.95. How much will it cost to plant the grass seed in the back yard? Show your work.

D. Aaron's Lawn and Garden sells grass seed by the pound. One pound of seed covers 100 square feet and costs $1.45. Would it be cheaper to buy the grass seed at Aaron's or at Tom's? Show your work and explain your answer.

E. Convert the side lengths of Matthew's back yard to yards. Show your work. Be sure to label every side.

F. If Aaron's Lawn and Garden sells fencing for $3.35 per yard, how much will it cost Matthew to put the fence around his yard?

APPENDIX D: PLANT THE PARK; EXTENSION TO THE GRASS SEED TASK

Figure D.1: The Park

The picture above shows the walking path and Community Park at Woodlawn Middle School.

Our problem: We need to purchase grass seed to cover the area inside the walking path and concrete to pave the sidewalk.

A. How would you estimate the area of the sidewalk to be paved?

B. How would you estimate the area of the field? Keep in mind you are looking at an aerial shot of the park. See what you can determine using what you know about the objects visible to you in the photo. Be as descriptive as possible in your explanation, using diagrams if necessary.

C. How crucial is it for your measuring technique to give you reasonable results? Would it make a difference if you were over or under in your estimation? How big of a difference? What determines if the estimate is close enough? Explain your answer fully, giving examples for your reasoning

D. Estimate the approximate area of the field we are planting.

Now that we have an idea about the approximate area, we need to make a decision about the grass seed.

E. Research the different brands of grass seed to find out the following:

1) the best brand and type of seed for year round green grass using at least 3 sources for information and why you think these are the best brands

2) the least expensive grass brand and type of seed regardless of performance using prices from at least 3 local or internet businesses

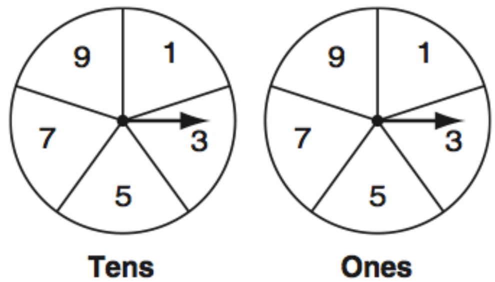
We need to decide on the grass seed based on what we have learned about price and performance. Here are a few more questions to consider before making a final choice:

F. Does the time of year that we are planting the grass seed make a difference in what kind of grass seed we can use? Find out. When is the best time to plant grass seed? What about the climate for our area, does that make a difference in the type of grass seed we can use? Answer all parts of the question.

G. How does one make a decision about what to purchase? What are some things you would consider before making your final decision?

APPENDIX E: THE ORIGINAL SPINNER TASK

Leann is using the spinners shown below to make two-digit numbers.



The first spinner is the tens digit; the second spinner is the ones digit.

Leann spins each spinner once.

A. What is the probability that Leann makes an odd number?

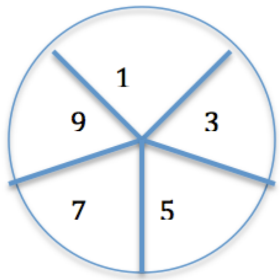
B. What is the probability that Leann makes the number 99?

C. What is the probability that Leann makes a number between 50 and 76?
Show or explain how you found your answer.

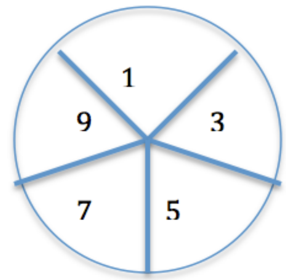
Figure E.1: The Original Spinner Task

APPENDIX F: THE REVISED SPINNER TASK

The spinners below can be used to generate two-digit numbers.



Tens



Ones

A. What are all the possible numbers that can be created with these spinners? Create a diagram or list to show your work.

B. What is the probability that you can create an odd number? Explain your thinking.

C. What is the probability that you create the number 99 with your spins? Explain your thinking.

D. What is the probability you create a number between 51 and 75? How can you sure?

Suppose the number 3 on the ones place spinner is replaced with the number 2.

E. How does that change your answer to part B? Explain with a chart or diagram.

F. Does the replacement of the number 3 with the number 2 change your answer to part A?

G. Now add the number 4 to the tens place spinner. Draw the new spinners: the 10's place spinner has 1, 3, 4, 5, 7, 9 and the 1's place spinner has 1, 2, 5, 7, and 9

H. What is the probability of creating an odd number with these new spinners?

APPENDIX G: GRADE 7 CRITICAL AREAS (FROM CCSS PG. 46)

The Critical Areas are designed to bring focus to the standards at each grade by describing the big ideas that educators can use to build their curriculum and to guide instruction. The Critical Areas for seventh grade can be found on page 46 in the Common Core State Standards for Mathematics*.*

G.1 DEVELOPING UNDERSTANDING OF AND APPLYING PROPORTIONAL RELATIONSHIPS

Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

G.2 DEVELOPING UNDERSTANDING OF OPERATIONS WITH RATIONAL NUMBERS AND WORKING WITH EXPRESSIONS AND LINEAR EQUATIONS

Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as

different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

G.3 SOLVING PROBLEMS INVOLVING SCALE DRAWINGS AND INFORMAL GEOMETRIC CONSTRUCTIONS, AND WORKING WITH TWO- AND THREE-DIMENSIONAL SHAPES TO SOLVE PROBLEMS INVOLVING AREA, SURFACE AREA, AND VOLUME

Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real world and mathematical problems involving area,

surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

G.4 DRAWING INFERENCES ABOUT POPULATIONS BASED ON SAMPLES:

Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

APPENDIX H: IRB APPROVAL

Application for Exemption from Institutional Oversight

Unless qualified as meeting the specific criteria for exemption from Institutional Review Board (IRB) oversight, ALL LSU research/projects using living humans as subjects, or samples or data obtained from humans, directly or indirectly, with or without their consent, must be approved or exempted in advance by the LSU IRB. This Form helps the PI determine if a project may be exempted, and is used to request an exemption.

LSU

Institutional Review Board
Dr. Robert Mathews, Chair
203 B-1 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.6792
irb@lsu.edu | lsu.edu/irb

- Applicant, Please fill out the application in its entirety and include the completed application as well as parts A-E, listed below, when submitting to the IRB. Once the application is completed, please submit two copies of the completed application to the IRB Office or to a member of the Human Subjects Screening Committee. Members of this committee can be found at http://appl003.lsu.edu/osp/osp.nsf/$Content/Humans+Subject+Committee?OpenDocument
- A Complete Application Includes All of the Following:
  (A) Two copies of this completed form and two copies of parts B thru E.
  (B) A brief project description (adequate to evaluate risks to subjects and to explain your responses to Parts 1 & 2)
  (C) Copies of all instruments to be used.
  - If this proposal is part of a grant proposal, include a copy of the proposal and all recruitment material.

  (D) The consent form that you will use in the study (see part 3 for more information.)
  (E) Certificate of Completion of Human Subjects Protection Training for all personnel involved in the project, including students who are involved with testing or handling data, unless already on file with the IRB.
  Training link: (http://cme.cancer.gov/clinicaltrials/learning/humanparticipant-protections.asp.)

1) Principal Investigator: Sarah Claire Dyer **Rank:** Graduate Student **Student*? Y/N** ____

Dept.: MNS **Ph:** 225.772.5650 **E-mail:** sdyer1@ebrschools.or

2) Co Investigator(s): please include department, rank and e-mail for each
* If student, please identify and name supervising professor in this space

3) Project Title: A Dual Approach to Building Secure Mathematical Knowledge: Combining Web-based Lessons with Valid Writing Tasks.

4) LSU Proposal?(yes or no) No **If Yes, LSU Proposal Number**____________

Also, if YES, either ◯ **This application completely matches the scope of work in the grant**

OR

◯ **More IRB Applications will be filed later**

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 4/23/2015

IRB# E5566 LSU Proposal# ______
☑ Complete Application
☑ Human Subjects Training

5) Subject pool (e.g. Psychology Students) Students at Woodlawn Middle School
- Circle any **"vulnerable populations" to be used**: (children <18; the mentally impaired, pregnant women, the aged, other). Projects with incarcerated persons cannot be exempted.

6) PI Signature Sarah Dyer **** Date** 4/1/12 (no per signatures)
****I certify my responses are accurate and complete.** If the project scope or design is later changed I will resubmit for review. I will obtain written approval from the Authorized Representative of all non-LSU institutions in which the study is conducted. I also understand that it is my responsibility to maintain copies of all consent forms at LSU for three years after completion of the study. If I leave LSU before that time the consent forms should be preserved in the Departmental Office.

*****Effective August 1, 2007, all Exemptions will expire three years from date of approval, unless a continuation report, found on our website, is filed prior to expiration date*****

Screening Committee Action: Exempted ✓ Not Exempted____ Category/Paragraph 1
Reviewer Mathews **Signature** RCM Mathews **Date** 4/24/12

Figure H.1: IRB Approval

(**Figure H.1** continued)

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 4/23/2015

Consent Form

1. Study Title: A Dual Approach to Building Secure Mathematical Knowledge: Combining Web-based Lessons with Valid Writing Tasks

2. Performance Site: Woodlawn Middle School

3. Investigator: The following investigator is available for questions about this study: Sarah Claire Dyer 225-772-5650 (M-F, 9-10:30 a.m.)

4. Purpose of the Study: The purpose of this study is to gather data to assess the impact writing tasks combined with web-based computational practice has on secure mathematical knowledge and conceptual understanding.

5. Subject Inclusion: 7th grade Math students in Mrs. Dyer's class

6. Number of subjects: 24

7. Study Procedures: The study will be conducted over a period of 4 weeks. The students will be given a pre-test to determine their level of achievement prior to the study. The students will work on their normal classroom lessons supplemented by a web-based program for computational practice. They will engage in 4 written tasks, one per week, developed from the constructed response practice questions in the Louisiana Comprehensive Curriculum. At the end of 4 weeks, the students will be given a post-test to measure growth, or retention of knowledge, particularly in their ability to answer constructed response items.

8. Benefits: The data subjects contribute in the study will be analyzed and may yield valuable information, which may be used to positively affect classroom strategies in mathematics education.

9. Risks: There is no potential risk to the subjects because it is the web-based program and writing tasks that are the focus of the evaluation, not the students themselves. All collected data will be kept separate from any identifying information.

10. Right to Refuse: Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.

11. Privacy: Rules of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.

(**Figure H.1** continued)

12. Signatures:

The study has been discussed with me and all my questions have been answered. I may direct additional questions regarding study specifics to the investigator. If I have any questions about subjects' rights or other concerns, I can contact Robert C. Mathews, Institutional Review Board, (225) 578-8692, irb@lsu.edu, www.lsu.edu/irb. I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Subject Name: ______________________________

Guardian Signature: ___________________________ Date:________

(**Figure H.1** continued)

Study Exempted By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Exemption Expires: 4/23/2015

I, ______________________________, agree to participate in a study to help develop teaching methods that allow students to remember more of what they have learned in math class. I agree to let my classwork be used to analyze teaching methods, and understand that my performance is not what is being studied, rather the teaching method. I understand that I can choose to not have my work included as part of the study without suffering any negative effects in class or concerning my grade.

Student Signature________________________ Date________ Age_______

Witness______________________ Date________

VITA

Sarah Claire Dyer is a native of Atlanta, Georgia, but has lived in Baton Rouge, Louisiana, since 1983. She received her Bachelor of Science in Elementary Education from Louisiana State University in 1988, after student teaching at one of Louisiana State University's sister schools overseas. She has been teaching in the Baton Rouge area since 1989, with all but one of those years spent teaching middle school. She has been married to Dennis Dyer for 29 years and has three grown children, all seeking degrees in education.