Implementing a Digital Mathematics Curriculum to Improve Student Performance

by

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Abstract

Standardized mathematics tests measure students’ ability to think critically and solve problems. In an effort to improve student performance, school corporations with below-average test scores are seeking alternative curriculums to the traditional textbook format. With grant funding, the Anderson Community School Corporation transitioned to a digital curriculum entitled Agile Mind. This online program uses a variety of animations to present traditional textbook information. Through analysis of the digital curriculum, I determine its alignment to the Common Core State Standards and the Prentice Hall Algebra I textbook previously used in the classroom. I also discuss the various implementation techniques and experiences of a specific mathematics teacher within the Anderson Community School Corporation.

Acknowledgements

I would like to thank Dr. Elizabeth Bremigan for advising me through this project. Completion of this task would not have been possible without her endless assistance and encouragement.

I would like to thank Lucinda Weatherford for introducing me to the Agile Mind program and allowing me to observe her implementation techniques.
The Problem

The city of Anderson, Indiana is located in the east-central portion of the state and contains approximately 57,000 residents. Originally a manufacturing community, poverty has stricken the area since the turn of the century and the close of many factories. The median income for an Anderson family is only $33,000 a year, about $10,000 less than the state median (Education-Portal.com). Given the high poverty levels, combined with the decrease of government funding for education, the Anderson Community School Corporation has had a challenging time providing innovative educational opportunities for their students. In an effort to save money and provide a beneficial educational experience, the corporation decided to restructure the 8,800 students within their corporation.

Beginning with the 2010-2011 school year, the corporation consists of five elementary schools (grades K-3), two intermediate schools (grades 4-6), one junior high school (grades 7-9) and one high school (grades 10-12) (Anderson Community School Corporation).

In May 2010, I completed my student teaching experience at Eastside Middle School, one of the former middle schools in Anderson. I worked with eighth grade students in the areas of Pre-Algebra and ISTEP Remediation. Although my experience was very rewarding, the lack of technological resources limited my ability to provide a creative and appealing learning environment for my students. In an effort to engage my students, I had to dig through activity books and spend hours planning lessons. I also developed my own note pages for each chapter to provide clarification and direction when my students were completing homework or preparing for tests. Although I feel that I provided a diverse learning environment through a combination of direct instruction, worksheets, activities,
and games, I feel that I could have given them more interesting information if provided with the opportunity to use technological resources.

Throughout my student teaching experience, I learned of a problem that could perhaps be directly related to the lack of technological resources available for effective instruction. Standardized test scores measure students' abilities to think critically and solve mathematical problems. Looking at Anderson's ISTEP scores from the 2009-2010 school year, only 61% of the sixth grade class, 57% of the seventh grade class, and 54% of the eighth grade class passed the math portion of the test (Indiana Department of Education). The Algebra I End of Course Exam showed even more disturbing poor results with only 10% passing in 2008 and 14% in 2009 (Search School and Corporation Reports). With goals of 90% of the students passing both tests, the corporation realized they were going to need to make some drastic educational decisions in order to increase their scores.

A Possible Solution

In order to ensure that the teachers within the Anderson Community School Corporation were equipped to help students raise their test scores, administrators looked into shifting from the traditional instructional techniques of many teachers to an alternative form of technology-based instruction. Funding for the implementation of a new, top of the line digital curriculum, however, is very expensive. With a high poverty level, the corporation had to look towards grant programs in order to make their aspirations a reality. They discovered the Classroom Innovations in Mathematics Grant, which is funded through the Senator David C. Ford education technology fund, and they began working towards a new mathematics curriculum for the 2010-2011 school year. This particular
funding cycle (2010-2011) is dedicated to integrating innovative instructional technologies into the mathematics curriculum (Indiana Department of Education). With Anderson's desire to change their curriculum and boost their test scores, they decided to implement it into their brand new junior high school consisting of grades seven through nine. The grant is designed to use interactive whiteboards and digital curriculum as the primary tools for instruction, with the textbook being used as a supplementary resource (Indiana Department of Education). Results from this new approach can provide schools with the necessary data to determine if the program should be permanently adopted.

Local educational agencies (LEAs) were eligible to apply for the grant and up to twenty entities would receive a portion of the $2,000,000 available to implement the grant requirements. Funds in the amount of $30 per student and $300 per teacher would be provided to register for the necessary programs and aid in professional development. Interactive whiteboards and computers would be purchased with grant money in order to comply with the grant's requirements. At the completion of the grant in 2011, the school has the ability to retain all of the technological devices purchased through the grant, providing them with the opportunity to implement similar programs in the future (Indiana Department of Education).

Before proposing to obtain the grant, it was vital to the corporation to understand the necessary requirements for compliance. Within the junior high school, at least 80% of the core material must be taught through the digital curriculum program chosen by the corporation. In addition to the selected digital curriculum, the corporation must also use online Acuity assessments for all students, including Algebra students, to test their progress at specific times throughout the school year (Indiana Department of Education). A
McGraw-Hill program, Acuity tests are standards based and used to predict the scores of future standardized tests. With this program, teachers can print out data to determine where students seem to be struggling and review any necessary material (CTB/McGraw-Hill). Since the corporation already used the Acuity program in 2009-2010 school year, teachers were willing to continue using this program. The final component for the grant was to use computers to take the necessary ISTEP and Algebra I ECA tests online. After looking over the requirements, the corporation felt very comfortable with the overall grant and decided to apply. Within the proposal, the corporation requested funds for interactive whiteboards and instructional tools for 19 classrooms that will serve 72 different math sections within grades seven through nine. Also, they requested funds for twelve computer labs to provide computers that will be used for ISTEP, Acuity, and any necessary assessments to complete the digital curriculum. A total of $231,254.82 was requested to meet the requirements for the grant (Indiana Department of Education).

With a record of below-average test scores and a dire need for innovative educational resources, Anderson Community School Corporation was a prime candidate for the Classroom Innovation in Mathematics Grant and soon received word that they had been chosen to participate in the program during the 2010-2011 school year. The developed a weekly lab schedule, providing each of the 72 middle school mathematics classes with two scheduled lab periods. One hour would be used for the required assessment and the other hour would be used at the teacher's discretion to complete online activities and assessments within the chosen program. The management team, consisting of the curriculum director, superintendent, union appointed teachers, department head, data coach, and curriculum assessment technology specialist, would work to ensure that all
necessary professional development was completed by the teachers and that the program ran according to the requirements of the grant throughout the school year (Indiana Department of Education).

**Implementing the Solution**

In order to complete the grant requirements, Anderson administrators had to determine which digital curriculum would be the most beneficial to their students. Digital curriculum was defined by the Indiana Department of Education, the grant administrator, to be a curriculum that would utilize innovative strategies for instruction and represent a significant break from the traditional textbook-oriented instruction. The corporation chose the innovative program from Agile Mind: the Middle and High School Mathematics Initiative. Authored by the Charles A. Dana Center at The University of Texas, the Agile Mind program offers a system of online tools for supporting classroom instructional practices, meeting the professional development needs of teachers, and offering structured, interactive supports for students (Charles A. Dana Center).

The Middle and High School Mathematics Initiative focuses on providing outcomes similar to those desired by the Anderson Community School Corporation. The Initiative is designed to increase student engagement by means of interactive, standards-based content and assessments and consequently, raise student achievement in mathematics. Educators also benefit from this innovative curriculum. They can easily implement multiple representations and conceptual approaches into daily lesson plans. Also, the consistency of the functions-based foundation across all grades promotes student success. Overall, the
program outlines many specific outcomes that would greatly benefit the success of the students within the Anderson Community School Corporation (Charles A. Dana Center).

Alignment with Standards

When determining the efficiency of a digital curriculum, administrators must compare the included content to mathematical standards. Since standardized tests determine a student's proficiency within mathematics, a concrete list of guidelines must be determined in order to provide a concrete educational experience. Agile Mind is designed to follow the 2010 Common Core State Standards. As an initiative to promote coherency within the United States, the Department of Education has developed this set of standards that will take the place of individual state standards. These standards define what students should understand and be able to do during each year of middle school and throughout the remainder of their mathematical careers. Although no specific guidelines are set forth to accommodate English language learners or students with special needs, the Common Core State Standards are designed to allow for the widest possible range of students when accompanied by the appropriate accommodations (Common Core State Standards Initiative).

When navigating through the Agile Mind program for the Anderson Community School Corporation, the following information provides a detailed description of the relationship

![Figure 1](image-url)
between the program and the Common Core State Standards. Teachers can look at course materials for several different levels of mathematics instruction. For example, an Algebra I teacher has the ability to look at materials for Middle School Math 2 (essentially 7th grade), Middle School Math 3 (essentially 8th Grade), and Algebra I. In order to better assist educators, the mathematical standards for all three levels are also available. Teachers can use this information to determine what students should already be familiar with and create meaningful lesson plans that build on their previous knowledge. The topic of formulating and solving systems is outlined in Figure 1. Algebra I teachers can clearly see that their students should have learned that solutions to a system of two linear equations in two variables correspond to points of intersection on a graph and that they solve real world problems by using two linear equations with two variables during their eighth grade mathematics courses. When determining their lesson plans, they might choose to review some of this information before moving on to the Algebra topic of solving systems of linear equations exactly and approximately. Agile Mind provides concrete connections between topics covered at various grade levels in order to help educators create meaningful learning experiences for their students.

Another unique feature provided by Agile Mind is the ability to look at the 2010 Common Core State Standards in a number of valuable ways. Figure 2 shows that you may search for topics related to standards, standards related to topics, or look at specific standard descriptions. When looking at information in the “Topics to Standards” tab, you will see a list of topics and the appropriate standards that accompany that particular topic.
(see Figure 2 above). This type of search could be used to determine how much of a particular topic was covered in previous courses as well as provide significant insight into ways that students could review previously learned material before moving onto new ideas. Teachers could also use this particular search to ensure that they cover all necessary requirements for their grade levels. With this tool, Agile Mind provides educators with the ability to develop concrete lesson plans that will build on their students’ knowledge.

The second search option allows educators to look at the list of standards and determine which lesson plans within the program are aligned with them. Figure 3 below shows how each standard is defined and linked to particular topics. The teacher can simply click on a topic and review the selected material. This type of search allows teachers to make connections to topics learned earlier in the year. They can easily return to animations on earlier topics to refresh students’ minds on particular topics. This particular search could also serve as a checklist for teachers.

When preparing for standardized tests, teachers often want to make sure that they have covered all of the information outlined by the standards. They could easily look through this information with their students to determine which topics, if any, were skipped or difficult to understand.

The final section consists of a complete listing of the 2010 Common Core State Standards for grades 6 through 12. Since they were released only a few months ago, many
educators are unfamiliar with the arrangement and depth of these standards. This section is primarily used as an informational source for educators and parents on the mathematical requirements for their students. Overall, there are many benefits to the "Alignment to Standards" section provided by Agile Mind to the Anderson Community School Corporation. Educators have the ability to make connections between previously learned and new topics as well as create lesson plans tailored to the completion of specific standards. With this element, teachers are free to structure their curriculum in any manner, as long as the required standards are covered.

Alignment with Textbook

Although textbooks are not required when using Agile Mind, many teachers, students, and parents prefer the comfort of this traditional resource. Teachers can use textbooks when looking for additional examples or activities and also when assigning homework. With the low poverty rate in the Anderson Community, it is of no surprise that many households do not have an internet connection in order to access the program. Students and their parents may require the use of textbooks in order to catch up on missed material or simply practice difficult material. Therefore, the Anderson Community School Corporation has worked diligently to provide a classroom set of textbooks that students may check out and return.

Since textbooks and a digital curriculum are both being used within the school corporation, teachers must determine ways to link the two together. In anticipation of this situation, the creators
of the Agile Mind program have made an “Alignment to Textbooks” section similar to the “Alignment to Standards” section previously mentioned. Figure 4 shows the list of textbooks that educators can choose to align with the program (Agile Mind for Anderson Community School Corporation). The 2004 edition of Prentice Hall’s Algebra I textbook is used for all Algebra I classes within the corporation.

When looking through the Agile Mind program created for Anderson Community School Corporation, a teacher may choose to align the digital curriculum with a textbook in one of two ways: “Topics to Textbook” or “Textbooks to Topic”. The first of these two selections will provide a list of the Algebra I topics covered by Agile Mind and a simultaneous list of every place the topic is mentioned within the chosen textbook.

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<td>Fractions and decimals</td>
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<td>3. Variables and functions</td>
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<td>Overview</td>
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Although one might believe that mathematical topics have to be covered in a specific order at all times, this is not generally the case. As seen in figure 5, the first topic from the program is covered within chapters 1 and 2 of the textbook. Laws of exponents, the second topic from the program, is covered in chapter 8 of the textbook. Then the third topic on variables and functions is covered in chapter 5 of the Prentice Hall textbook (CTB/McGraw-Hill). It is apparent that one of the biggest issues with using the textbook as a supplementary resource to the Agile Mind program is the format of
the information. In order to use the textbook, the teacher would continuously need to
remind students where the
information could be found.

The alternative type of
alignment, “Textbooks to Topic,”
provides a list of every chapter
within the selected textbook and
the topics within the Agile Mind
program that accompany that particular chapter. Some sections of the chapters within the
textbook are correlated with several topics found within the program while other sections
are only mentioned in the topic overviews. Figure 6 above demonstrates the varying
amount of topics for each section. This alignment seems more appropriate for a school that
is using the program as a supplementary resource to the textbook. Since the Anderson
Community School Corporation is required to use the digital curriculum at least 80% of the
time, this alignment seems impractical (Indiana Department of Education).

In order to make a closer comparison of the textbook being used and the Agile Mind
program, I decided to look at the first chapter/topic of each. Within the textbook, the first
chapter, Foundations for Algebra, students will look at the various sections: Variables and
Expressions, Order of Operations and Evaluating Expressions, Real Numbers and the
Number Line, Properties of Real Numbers, Adding and Subtracting Real Numbers,
Multiplying and Dividing Real Numbers, The Distributive Property, An Introduction to
Equations, and Patterns Equations and Graphs. Within the program, the first topic, Rational
Numbers, includes the following subtopics: Positive and Negative Rationals, Integer Models,
Fractions and Decimals, and Order of Operations. As you can see, the titles for various sections are vastly different, but it is important to realize that some of the information is the same. For example, the material from the sections about real numbers in the textbook is covered in the topic Positive and Negative Rationals within the program. However, the sections on equations and graphs are not covered until later in the program. Overall, the information being presented in both traditional textbooks and the digital curriculum is similar, it is simply being presented in a different order.

Since many of the students lack internet access at home and must be able to use a textbook, it seems very beneficial for the Agile Mind program to have an alignment feature. However, the disorganization between the two curriculums could be detrimental to students' understanding. It is apparent that both curriculums cannot be used equally without creating confusion. Therefore, after the grant program, the Anderson Community School Corporation will need to make the difficult decision of whether they would like to continue paying for and using the digital curriculum or if they would rather return to the traditional textbook format.

**Classroom Implementation**

In order to gain an understanding of how the Agile Mind program was being implemented into the classroom setting, I observed one of the teachers at work. Since all of the mathematics teachers are required to be on the same schedule and many of them collaborate together to create lesson plans, observing one teacher provided me with an accurate representation of the overall implementation process. As many of the teachers began the school year, they tried to use an equal amount of information from the textbook
and the digital program. The teacher I observed said that she quickly discovered she was either jumping from chapter to chapter in the textbook or jumping from topic to topic in the program in an effort to make a single, cohesive lesson. In order to avoid confusion, she decided to follow the curriculum laid out within the program and use the textbook as a supplementary resource.

For each topic, the teacher prints a copy of each of the program’s pages for every student. The worksheets provide students with an overview of the topic as well as practice problems that could be used as homework assignments. Figure 7 is the beginning of a story problem that leads students through an overview of rational numbers. The overview for each topic reviews previously learned material that will be used when studying the new topic. The teacher I observed uses this tool to determine her students’ comprehension of the material and determine if further instruction is needed prior to proceeding through the new topic. Once the class is ready to begin the new topic, the program provides a series of animated story problems to present the information. During observation, I noticed that the teacher used these story problems wisely. She generally presents the problem at hand and gives her students the opportunity to propose their own solutions prior to going through the solution given by the program. This teaching method
allows students to critically think about real-life problems and develop problem-solving skills that will prove beneficial to them in their futures. With the use of this program, mathematics teachers at Anderson Community School Corporation have been given the opportunity to present material and build mathematical skills with somewhat greater ease than a traditional textbook can provide.

Not only did the Anderson teachers have to implement new ways of presenting material, but they also had to adjust to new assessment techniques. The teacher I observed often used “lab” time to assess students’ understanding of new material. Within the “assessments” tab on the program, students can complete guided assessments or self-test questions. Guided assessments provide students with a story problem containing words found in a word bank. Students must then choose the correct word for each blank to complete the problem. She claimed that she often assigned this type of assessment to struggling students and it helped them practice the basic information presented in the lessons. For students desiring a little bit of a challenge, she would assign self-test questions. With this form of assessment, students are given a word problem with numbers missing. They must then complete computations and type them into the boxes in order to correctly answer the
question. Both types of assessments are similar to quizzes that many teachers give their students.

Along with these quiz-like assessments students are required (by the grant) to complete an online test at the end of each topic. Two types of tests are available: multiple choice and constructed response. Both tests require students to work through computations to determine the correct solution. Upon completion of the tests, the teacher I observed uses various reports within the program to determine the overall comprehension of her students. She often chooses to look at the commonly missed questions or overall average scores of her students to determine if more time needs to be spent on the topic. Prior to the program, analysis of data was a very time-consuming task, but she now has the ability to see the progress of her students with the click of a button.

Now that Agile Mind has been implemented for several months, the teachers are more confident with using the overall program. They have adapted to the use of smart boards, projectors, and computers to present daily lessons. Students have also become comfortable with using the new technology and completing assessments online. Although the digital curriculum is a drastic transition from the traditional textbook method, both students and teachers seem to have learned and adapted very well to the many tools provided by the digital curriculum.
Discussion of Solution

The Agile Mind program offers an alternative form of instruction that could prove to be very beneficial to students within the Anderson Community School Corporation. Thinking back to my student teaching experience, it was a daily challenge to keep my students engaged and interested in the world of mathematics. I think the program's use of animations to present real-world problems associated with mathematical topics is a great way to foster student interaction and motivation. Another feature of the program that appears very beneficial is the reporting section. Mentioned in the implementation section, the teacher I observed uses this feature to monitor her students' progress and assess their understanding. With traditional techniques, the tasks of recording scores in a grade book, constantly checking through pages and pages of grades to determine missing assignments, and calculating class averages by hand are a bit overwhelming. This program eliminates the amount of time teachers have to spend working on these cumbersome tasks and provides them with detailed information at the touch of a button. Consequently, teachers can spend more time accommodating the needs of their students. These features, along with many others, prove Agile Mind's capability to assist both teachers and students in the educational process.

Although the overall program seems very beneficial, I noticed a few aspects that might prove to be challenging for corporations implementing this program. Since this curriculum is internet-based, it could prove challenging for students who do not have internet access at home. In order to overcome this challenge, teachers either have to print off the homework pages, which can become costly to the corporation, or provide them with homework assignments from a textbook. As discussed previously, aligning the program
with a textbook is rather confusing due to the varying order of topics presented in either curriculum. School corporations should discuss each of these notions prior to implementation. Although these challenges may seem a bit daunting, I believe a well thought-out plan could eliminate any discrepancies within the program. For example, providing students with computer access before or after school or working with local libraries to provide free internet access to students using the program might be possible solutions.

I personally believe that the Agile Mind program is an exciting, innovative way to present the same material that traditional textbooks offer. Just as many teachers supplement textbooks with additional materials, they may choose to supplement the digital curriculum as well. Overall, the topics being presented appear to be the same in both the textbook and digital program. If using a digital environment gets more students motivated to study and learn mathematics, test scores will most likely improve. Agile Mind and other forms of digital curriculums may prove to be the solution to raising the performance of students in low achieving school corporations.
Works Cited


