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Increasing Student Engagement in the Secondary Math Classroom

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INCREASING STUDENT ENGAGEMENT IN THE SECONDARY MATH CLASSROOM

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ABSTRACT

This thesis reports on a professional development package developed by the author to help three teachers increase the level of student engagement in their math classrooms. There were three phases: 1) initial presentation of strategies and sample lessons, 2) classroom implementation, 3) reflection and evaluation. As a result of the professional development, the Louisiana Compass Teacher Evaluation Rubric scores of the teachers improved. This thesis can be used as a guide for principals or instructional specialists who wish to provide professional development for small groups of teachers, with a focus on increasing student engagement.

CHAPTER 1: INTRODUCTION

In this thesis, I report on a year that I served as Assistant Principal and as the Instructional Coach to three teachers in the math department at a small rural school. The teachers included one veteran math teacher with five years of experience and two new teachers who were hired through the Teach for America program. My role as Instructional Coach required me to observe the teachers using the Compass Teacher Evaluation Rubric throughout the year and to provide assistance to the teachers in the areas of classroom management, curriculum and instruction.

When evaluated using the Louisiana Compass Teacher Evaluation Rubric, the teachers scored lowest in the area of student engagement. In response, I designed a professional development package based on inquiry-based learning methods and the 5E lesson plan model to help teachers engage more students in the classroom. The professional development was completed in three phases. Teachers attended an initial presentation of the problem and activities they would use to solve the problem, they implemented the strategies in their classes, collaborated in determining how effective the strategies were and in making adjustments. Finally, they were observed to determine if the methods were successful.

The effectiveness of the professional development package was evaluated by the teachers' scores on the Louisiana Compass Teacher Evaluation Rubric and by the level of student engagement reported by teachers on the activity reflection forms. Based on the teacher reflections and my observations, the methods that the teachers learned how to use can have a positive impact on student engagement, but the right class routines and procedures must be implemented, the teacher must facilitate the lesson, the lesson must be well planned, and students must understand the expectations and have some prior knowledge of the content.

The goal of this thesis is to provide teachers with tools that will help them deliver lessons that are engaging for students. Included in this thesis are a few sample lessons teachers can use to shift classroom instruction so that more students are engaged in the lesson. I will describe the impact that a program of professional development had on classroom instruction and how it shifted instructional strategies to help increase student engagement.

The Common Core State Standards (CCSS) implemented by Louisiana in 2012 include the 8 Standards for Mathematical Practices. These standards describe the mathematical skills and dispositions that all teachers should develop in their math students. As they implement these standards in their classrooms, teachers will have to use different teaching methods to ensure their students develop in the way the standards recommend. There must be a shift from the traditional direct instructional methods currently used in many math classrooms to non-traditional methods that better encourage student engagement.

Teachers in Louisiana evaluated using the Compass Louisiana Teacher Evaluation tool and are expected to score in the Effective/Highly Proficient range. The evaluation instrument contains 3 domains that include a total of 5 components to measure teacher effectiveness. Student engagement is one of the components in the instruction domain. Teachers are expected to provide students with activities that increase student collaboration and help them acquire the skills to communicate mathematics in writing and verbally.

The CCSS provides us with math practices teachers should focus on in the classroom. The state of Louisiana is creating policies and instruments to support the transition, which is valuable because the CCSS document does not include the strategies and procedures that can be used to ensure students are actively engaged in the classroom. This creates a challenge for professional development.

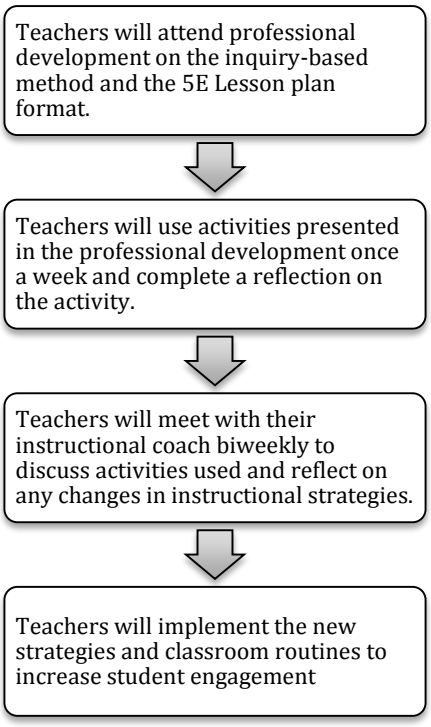
When I became their principal, the three teachers who were the subjects of this thesis primarily used the direct instruction method that required very little student-initiated questions and peer discussions. Teachers presented the lesson; students copied notes and then were given more examples to complete. Finally, they received an independent assignment. Very few of the lessons included open-ended or thought-provoking problems. This needed to change. Student-initiated questions and peer discussions are classroom formats that are of extreme importance in the Common Core and on the Compass Teacher Evaluation instrument.

The math teachers' practices in the classroom were patterned in the traditional mode. The teachers did not have any routines that they could employ to encourage students to express themselves mathematically. If students were going to reach the new Common Core standards, teachers needed to provide them with the learning opportunities to succeed and they needed to get students more involved in the lesson by providing them with activities that encouraged student engagement (Stigler & Hiebert, 1999).

To assist these teachers, I designed a professional development and training seminar for the purpose of helping them change their classroom culture to help them make a shift from direct instruction to a classroom that is student centered. The professional development included a review of the Compass Instruction Domain 3, Component 3c and the eight Common Core State Standards of Math Practices. In addition to the standards, I also introduced to them an Inquiry-Based Model lesson plan called the 5E model. It included in the Biological Science Curriculum Study, a team led by Roger Bybee (2006). The professional development concluded with sample lesson plans and a 5E lesson plan template teachers could implement in their classes.

The logic model that guided this project is shown in the following figure.

Plan for Teacher Assistance



The need to assist the teachers to increase student engagement by using inquiry-based methods was evident from information gained while conducting teacher observations and observing students as passive participants in the classroom activities. This professional development served two immediate purposes: (1) to provide teachers with assistance with Compass Domain 3, Component 3c and (2) to help teachers motivate students to participate in class by providing them with activities that would increase student engagement. The overall purpose was to change teacher practice.

Through my research and teacher observations, it was evident that teachers needed the following to change the culture of their classrooms:

(1) Lesson plans that emphasized engagement.
(2) Classroom routines.
(3) Sample activities to increase student engagement.

The professional development discussed in this thesis was designed so that teachers could immediately use the information presented to become stronger mathematics instructors thereby creating mathematical thinkers. Throughout this process, all participants realized that before student engagement could take place, routines and procedures had to be in place in the classroom.

Following the introduction, there are 4 additional chapters in this thesis. Chapter 2 is a summary of the Louisiana Teacher Evaluation Rubric and the importance student engagement routines are to the classroom environment. Chapter 3 is a review of some relevant literature on the following topics.

- Student engagement through inquiry-based learning
- The 8 Standards for Mathematical Practice and the importance of these standards in the math classroom.
- The 5E Lesson Plan Model and how it can be used in a math classroom to encourage student engagement through an inquiry-based learning process.

Chapter 4 includes a description of the professional development teachers participated in to help increase student engagement in their classroom and the observed outcomes. Finally, chapter 5 includes the results and conclusion.

CHAPTER 2: LOUISIANA TEACHER EVALUATION AND STUDENT ENGAGEMENT

This section includes a summary of the student engagement component of the Louisiana Teacher Evaluation Instrument. The instrument is largely based on The Framework for Teaching written by Charlotte Danielson.

The Louisiana Compass Teacher Evaluation Rubric is adapted from the Framework for Teaching and Evaluation Instrument developed by Charlotte Danielson (2011). The rubric consists of 3 domains and 5 components. This section focuses on Domain 3: Instruction, Component 3c: Engaging Students in Learning and how teachers can use an inquiry based learning environment to increase student engagement (Danielson 2011).

In Charlotte Danielson's opinion, student engagement is the most important component of the framework for teaching and all other components contribute to it (Danielson, 2011). Like Danielson, my experiences as a classroom teacher indicate that when students are engaged they are not merely assigned to doing busy work or completing work, they are actively involved in the lesson and are asking questions of themselves, the teacher and their peers. Teachers who use Danielson's framework design lessons with a beginning, middle and end based on the Common Core State Standards and the 8 Standards of Mathematical Practice that provide cognitive challenge and encourage students to reflect on what they have learned (Danielson, 2011). Evidence of student engagement in the classroom can be obtained by observing how students are communicating with the teacher and with their peers orally and in writing, and observing the other elements of student engagement listed in Table 1.

Danielson also agrees that classroom management procedures and routines are essential to creating an environment that is conducive to learning. All of the elements included in the student engagement domain of the Danielson Framework for Teacher Evaluation (see Table 1)

are important. Routines should be established in such a way so that teachers and students function at an automatic, subconscious level each day in class (Appleton, 1995).

Danielson's advice and views on classroom management leave out an important factor that I have come to understand during my experience as a teacher of over fifteen years. Oftentimes, students will challenge the routines and procedures of a classroom. Therefore, it is essential to get student input so they can "buy-in" to the routines. If students contribute to developing the rules and procedures, there tends to be very little discipline issues in the classroom.

Table 1. Elements of Student Engagement
(from the Charlotte Danielson Framework for Teacher Evaluation)

Element of Component	**Description**
Activities and Assignments	• Promote learning and are aligned with the goals of the lesson • Learning tasks that require high-level student thinking.
Grouping of Students	• Group selection may be based on skills, background or other factors • Students may be allowed to choose their own groups.
Instructional Materials and Resources	• Make sure the materials and resources are aligned with the CCSS. • Use resources/materials that engage students to encourage in depth learning.
Structure and Pacing	• Make sure the lesson has a beginning, middle and end. • Make sure class is structured so that time is allowed for reflection and closure • Pace is neither dragged nor rushed.

Danielson's Framework for Teacher Evaluation describes how important student engagement is in the classroom. Danielson's model also includes the Elements of Student Engagement as described in Table 1. The components in Danielson's model along with appropriate routines help ensure student engagement occurs.

CHAPTER 3: LITERATURE REVIEW

There is extensive research on the importance of student engagement and inquiry-based learning, how these affect and are affected by habits of mind and how to design lessons with these goals in focus. This chapter surveys research conducted by other professionals on how to help increase student engagement. We also look at work on how engagement impacts student achievement. This chapter also includes information on:

a) How inquiry-based learning has been used in other math classes along with the 5E lesson plan model.
b) How implementing the 8 Standards of Mathematical Practice can help create a more inquiry-based environment to increase student achievement.

The Literature included in this chapter was selected through a search of scholarly articles from university online libraries and Google Scholar.

3.1 Student Engagement using Inquiry-Based Methods

Research tells us a lot about how student engagement can increase a students' learning experiences in the classroom. Research has also be conducted on how inquiry-based methods can be used to increase student engagement. This section includes literature explaining student engagement from the viewpoint of other scholars and describing inquiry-based learning and how teachers can use this model to increase student engagement.

Skinner, Kindermann and Furrer (2009) describe student engagement as the quality of a student's involvement in school and a student's interactions with classroom activities and materials that produce actual learning thereby shaping children's academic retention, achievement, and resilience. Students who are engaged in classroom activities initiate action, exert extensive effort, show positive emotions during the task assigned in addition to being

enthusiastic, optimistic and interested in the results of the assignment (Skinner & Belmont, 1993).

Henningsen and Stein's approach to student engagement is to provide students with mathematical tasks that require them to think at a higher level. Henningsen and Stein (1997) suggest that students' ability to complete higher level mathematics will change when classrooms become environments where students are able to engage in mathematical activities that are rich and worthwhile.

An inquiry-based mathematics classroom is a non-traditional classroom where teachers and students both think differently about how math is presented in the classroom (Lampert, 1990). The inquiry-based classroom is one that is more student-centered than a traditional teacher-centered classroom. In an inquiry-based classroom, teachers hear and interpret what students are saying in order to immediately clear up any misconceptions students have, design questions that prompt students to think and ask questions, and encourage students to move beyond what is actually presented to them (Douglass & Horstman, 2011). Their purpose is to create mathematical thinkers who can communicate math verbally and in writing.

When students are first introduced to the inquiry-based process in math classes, they are usually apprehensive since this type of instruction is unconventional in a math classroom. Inquiry-based practice is more often found in science classes than in math classes. It is the teacher's role to make sure that students understand the routines and procedures in the inquiry-based environment. Teachers must be able to guide the students in communicating their justifications and learning to speak mathematically. They can do this by modeling the thinking process for students using prompts such as, "Can someone further explain the process?" or "Does the solution make sense?" (Douglass & Horstman, 2011)

Wongapiwatkul, Laosinchai, Ruenwongsa and Panijpan (2011) describe inquiry in a math class as guided-inquiry instruction that encourages students to actively participate in their learning with the teacher in the role of the facilitator. They indicate that in a guided-inquiry instructional setting, students are able to gain the ability to analyze, evaluate, synthesize information and take that information to apply it to other disciplines. This method of instruction also helps the students gain knowledge and understand the mathematics needed to complete classroom tasks. The article further states that guided-inquiry instruction, leads to higher motivation and better mathematical ability, interest and achievement.

Wongapiwatkul, Laosinchai, Ruenwongsa and Panijpan (2011) used their views of guided-inquiry instruction to develop an inquiry-based unit on "The Earth and Trigonometry", to enhance students' understanding of basic trigonometry and geometry as they relate to the traditional instruction of longitude, latitude, the great circle, the meridian and the dateline. Sixty-two eleventh grade students from two different schools in traditional trigonometry classes were included in the study. The four-hour long activity was completed in two class periods (2 hours each) and consisted of five phases. Throughout the activity the teacher was in the role of facilitator. Each phase of the activity was designed to encourage student engagement and critical thinking so that students would better understand the concepts presented to them. The results of the study were that students had a good understanding of basic trigonometry, a fair understanding of latitude, longitude and applied trigonometry and a poor understanding of the great circle distance. The authors felt that if more time were devoted to discussing the great circle distance, students would have had a better understanding of the topic. Other factors affecting student achievement include the students' background in trigonometry, the teacher's ability to facilitate the inquiry-based activity, and the teacher's knowledge of the content.

Students at one school were more successful than students at another school because of their level of knowledge of trigonometry.

Marshall and Horton (2011) observed more than 100 math and science classes to determine the effect of using inquiry-based methods with their students. They found that the teachers who required their students to explore concepts before the lesson was explained to them were involved in the lesson discussion at a higher cognitive level. There appeared to be a positive correlation between student performance and the amount of time spent exploring and a negative correlation between the time teachers spent explaining the concepts to the students. They found that the teachers were successful in engaging their students thereby challenging students with higher order activities.

Stonewater (2005) conducted a study on the perceptions of prospective middle school teachers in an inquiry-designed classroom. At the beginning of the course, teachers completed an essay where they described their view of the best math class. As a result of the essays, the teachers were placed in two different categories: The Watch-Learn-Practice group and the Self-Initiator group. The Watch-Learn-Practice group described the best math class as a class that was teacher centered. In this type of class, the teacher answered all of the questions, reviewed the homework and gave students an assessment that was similar to the homework given. The teacher did not give the students any problems that were not previously reviewed with their students. Teachers in this group, believed that it was unfair to give students assessments that were different from homework assignments. Teachers assigned to the Self-Initiator group, described the teacher's role as that of a facilitator rather than just giving out information. In this type of classroom, students completed collaborative tasks rather than just watching the teacher complete tasks. The student were able to complete more difficult problems together and believed

that they were capable of succeeding. During the course, teachers in both groups were given different labs to complete throughout the course that required them to work together in groups rather than work alone. Teachers in the traditional Watch-Learn-Practice group realized that it was more effective to have students work together to discuss strategies for solving different math problems than to have them work alone and wait for the instructor to explain the method. The teachers also realized that working in a group meant that everyone had to work together to determine the solution. At the end of the study both groups realized that in an inquiry-based environment, students are expected to go beyond the basic requirements and to think deeply about the mathematics needed to complete the problem (Stonewater, 2005).

Herzog (2010), from the Ohio school system, describes an inquiry-based classroom as one where the teacher is not only the giver of information, but also facilitates the learning process, allowing students to take ownership of their education. In 2008, the state of Ohio implemented the Ohio Core Curriculum program in an effort to improve STEM instruction in all schools. The core curriculum program was designed to ensure that all students were prepared for college. It required students to take four math classes instead of three and it mandated that science courses be taught in a lab format using inquiry-based methods. The program focused on using tools of math and science, technology and inquiry-based lab experiences to create mathematical thinkers with research skills and the ability to reason and discover things on their own.

Many authors assert that today's students should be equipped with higher-order skills enabling them to reflect on their own thinking process and self-assess their knowledge and intellectual development (Moreillon, Lubtala, & Russo). They say that educators must provide students with opportunities to take risks. Students should be unafraid of saying they don't know

how to do something and should be willing to try to approach the problem in many ways in the effort to succeed. Teaching risk-taking is challenging since it involves teachers giving students more control in the classroom by allowing them to think freely and make independent choices. (Moreillon, Lubtala, & Russo, 2001).

Not everyone is in agreement with inquiry based learning for the mathematics classroom. According to Kirschner, Sweller and Clark (2006), inquiry-based learning is not the most effective way of instructing students. They contend that if a student does not have adequate knowledge of the material, unguided project-based or inquiry methods of instruction do not work. Students tend to become frustrated and confused when given tasks to complete in an unguided format where the teacher is in the role of a facilitator. Kirschner, Sweller and Clark's findings are the results of years of research comparing direct instruction with unguided instructional techniques.

McLoughlin (2009) conducted a study with undergraduate university students to determine how inquiry-based learning can be used at the college level. In his opinion, inquiry-based learning is a lesson design that should be used to move away from passive classrooms. McLoughlin (2009) describes inquiry-based learning as a master and apprentice; the teacher is the master of the content and the student is the apprentice who is looking to the teacher for information about the content.

The literature reviewed in this section, included professionals who used inquiry-based methods to create classes that were student centered. The literature reviewed also provided evidence that inquiry-based strategies can be used in a classroom successfully if the activities are relevant and teachers are familiar with the process. To ensure the success of activities used to

increase student engagement, teachers must ensure students realize that the culture of their class must change.

3.2 The 8 Standards for Mathematical Practice

The Common Core State Standards define what students should understand and be able to do throughout their study of math. The Common Core includes the eight Standards for Math Practices (see Table 2) that should be found in all math classes to ensure student success. Standards for Practices 1 through 5 include standards of problem solving, reasoning and proof, communication, representation and connectors. Standards 6 through 8 focus on mathematical proficiency (comprehension of concepts, operations relations and the skills in carrying out procedures).

Table 2. The 8 Standards of Mathematical Practice
Common Core State Standards, (2011)

STANDARD		WHAT STUDENTS SHOULD BE ABLE TO DO
1	Make sense of problems and preserve in solving them.	• Look for the meaning of the problem and entry points to the solution. • Check answers to problems and determine if the answer make sense.
2	Reason abstractly and quantitatively.	• Make sense of quantities and their relationships in problem situations. • Be able to use different properties, operations and manipulate equations.
3	Construct viable arguments and critique the reasoning of others.	• Try to disprove or prove conjectures through examples and counterexamples. • Communicate and defend mathematical reasoning using techniques such as drawings, actions, verbal and written communication.
4	Model with mathematics.	• Apply math to solve problems in everyday life. • Analyze relationships mathematically to solve problems.
5	Use appropriate tools strategically.	• Know when to use appropriate tools to solve math problems (graphing calculator, computer, protractor, ruler, etc.).
6	Attend to precision.	• Be able to communicate results precisely to other students. • Use definitions correctly in verbal and nonverbal communications. • State the meaning of definitions, use the appropriate units and label figures correctly.
7	Look for and make use of structure.	• Try to determine a pattern or structure and use it to solve the problem.
8	Look for and express regularity in repeated reasoning	• Identify calculations that repeat general methods, short cuts, attend to details, contribute to evaluate the reasonableness or results.

The Common Core State Standards for Mathematical Practice (Table 2) are designed to help teachers strengthen students' mathematical reasoning, mental math skills and critical thinking skills. Marilyn Burns, (2013) stated that one of the challenges of teaching is to listen to the way students reason rather than to listen for the responses we expect to hear. Helping students develop reasoning skills should become a part of the classroom culture.

Implementing the CCSS for math effectively involves teachers providing students with activities that require them to reason mathematically. Teachers should observe students solving problems, explaining their reasoning and should listen for any misconceptions to help them determine what they should include in future class discussions.

Middle-school teacher Jessica Hiltabidel (2013) changed the culture of her classroom in an effort to implement the Common Core Standards. Hiltabidel used inquiry-based lessons to help get students involved in class. After her work, in her state's end of the year assessment, her students scored better on the skills she taught through inquiry than on the skills she taught the traditional way. Her thoughts on the classroom environment changed as a result. According to Hitabidel, (2013) students should be engaged in a productive struggle that will help them become comfortable with the eight Standards of Mathematical Practices (Table 2). This will require teachers to relinquish some control of their classrooms and allow students to struggle independently and collaboratively, using inquiry as the main instructional tool.

The teacher's role in the classroom has to change to successfully implement the Standards. The teacher must serve in the role as the facilitator and allow students to persevere through the process of finding a technique for solving new problems. Teachers should have a classroom environment where students are comfortable when they are struggling. Students should learn that because they have a difficult time completing a task, it does not mean they are

not learning the skills. Inquiry-based lessons give students the opportunity to figure out for themselves and rely on the first of the 8 math practice standards: Make sense of problems and preserve in solving them (Hitabidel, 2013).

Changing a traditional classroom to an inquiry-based classroom is one way of increasing student engagement in the math classroom. Hitabidel (2013), found that transitioning from the traditional way of teaching to an inquiry based instructional environment helped to implement the math standards of practice included in the Common Core State Standards, increased student engagement, encourage students to work collaboratively and helped to increase students' critical-thinking skills.

3.3 The 5E Lesson Plan Model

Research has shown that to help increase student engagement through inquiry-based learning, teachers must be able to plan effectively. One planning method that has been used in science that is now being used in math classes is the 5E lesson-plan model. The 5E lesson-plan model has been used for over 30 years in to develop new curricula and assist with professional development (Bybee, et al., 2006). The model was developed by The Biological Sciences Curriculum Study Team, led by science-educator Roger Bybee. The model is constructivist, focusing on learners building their own understanding of new ideas. It includes the following phases: engagement, exploration, explanation, elaboration and evaluation (Bybee, et al., 2006). Each phase of the model is designed to get students more involved in the lesson while having the teacher acting in the role of the facilitator. The lesson model is not designed to leave students on their own with the belief that they are teaching themselves. It is designed to gradually guide students through the inquiry learning process.

Since the 5E lesson plan model has been successfully implemented in science classrooms, there is reason to believe it may also be used in mathematics classes to shift the focus from a traditional classroom setting to a more inquiry-based setting. As in the science classes, students will be required to explore, explain, describe and form their own conclusions instead of having the teacher give the procedures and rules they needed to solve problems. With the CCSS and the Mathematical Standards of Practices requiring students to be able to understand and develop reasoning skills, the 5E inquiry model contains all of the phases that will assist teachers in helping students become better mathematical thinkers. A description of each phase is listed below in Table 3.

Table 3. The 5E Lesson Model

Phase	**Description**
Engagement	Motivate students for the lesson by building on prior knowledge. (Often known as the lesson HOOK.) The teacher provides rules and directions for the rest of the lesson.
Exploration	Teacher provides students with activities to help them form their own conclusions. Teacher supervises, guides students and prompts them when needed. Here is where the inquiry action occurs that allows students to ask questions such as "what if" and "why". Students investigate different possibilities to arrive different conclusions.
Explanation	Students express what they've learned to the class, their group or other groups. Students should be able to demonstrate their conceptual understanding. Teachers can introduce the topic more directly.
Elaboration	Students extend their discussions. Teachers clear up any misconceptions and introduce new vocabulary. Students practice their skills.
Evaluation	Teachers determine how much students understand. Students assess their own learning, answer open ended questions, write summaries and take a quiz. Students complete Independent Practice.

Research has shown that when students are more active, more learning takes place. Teachers should understand students' knowledge, learning ability and the course content when developing inquiry-based activities. To change the classroom culture into one where student

engagement is increased, appropriate routines and procedures must have been developed and understood by all students in the classroom. In addition to established routines, research has also shown that without adequate prior knowledge of the material presented in an inquiry-based lesson, students will not achieve success if they possess limited skills to complete the assigned tasks.

CHAPTER 4: THE PROFESSIONAL DEVELOPMENT

This chapter contains a description of what I did in the professional development program that I designed and it explains how teachers changed the culture of their classroom. The activities used in this professional development program were motivated by previous research and the results of teacher observations conducted. The goals were set by the school district and the state.

The master teacher and teachers in the math department at West St. John High School participated in the professional development in the fall of 2012. The teachers in the department consisted of two first-year teachers and one teacher with three years of experience teaching the following courses: Pre-Algebra, Algebra I, Algebra II, Geometry, Advanced Math and Trigonometry.

The purpose of the professional development package was to provide teachers with resources they could use in their classrooms to increase student engagement. It was evident that there was a need for this type of professional development after observing the teachers and students in the math department during classroom instruction. The teachers did not have routines, procedures or strategies to use in their classrooms to ensure student engagement. The teachers scored lowest on the student engagement component of the Louisiana Teacher Evaluation Instrument which was an indication that assistance was needed.

The professional development package teachers in my study participated in consisted of three phases:

1) Phase 1: The Presentation
2) Phase 2: Classroom Implementation
3) Phase 3: Meetings and Results

In Phase 1, all participants attended a presentation where they received detailed descriptions of activities, routines and procedures research has shown to help increase student engagement. Phase 2 required teachers to implement the information gathered in phase 1 in their classrooms and complete the reflection activity form they received in Phase 1 recording the students' level of engagement during each new activity students completed. Finally, in Phase 3, teachers were required to meet each week to discuss their observations and results.

4.1 Phase 1: **The Initial Presentation**

In the initial meeting, we first began with a Think, Pair, Share activity where teachers described student engagement in their classrooms. The two new teachers stated that one form of student engagement in their classroom is to have the students complete their guided practice assignment in groups or in pairs. While the master teacher and the veteran teacher agreed that this was a form of passive student engagement, they knew that there were other ways of engaging students in a more active way the classroom. However, both felt that there was little time to do so in the classroom. Further discussion revealed that the teachers were hesitant about giving up control in their classrooms. They felt that students were not mature enough to be able to discuss math in groups, or they just did not want to move into the role of class facilitator.

The next part of the presentation was a discussion of the CCSS and the Standards of Mathematical Practices. Some of the teachers had not taken the time to explore the standards, so they were not very familiar with them. We discussed how the standards required students to have a higher level of engagement. That engagement is more than having students complete a worksheet or some other activity for guided and independent practice. We then discussed the student engagement component of the Framework for Teacher Evaluation Rubric and compared the objectives of the component to the CCSS Standards for Mathematical Practices.

It was important for the participants to see different levels of student engagement and the effect the levels of engagement had on the class environment. Participants analyzed videos of students completing different activities, the level of student engagement in each activity, and the role of the teacher. After viewing the videos, we discussed how participants might increase student engagement. The inquiry-based learning method was then introduced. This portion of the professional development included the definition of inquiry-based learning, the advantages and disadvantages of the method and how adjusting their lesson plans to the 5E Lesson Plan Model can help change their classroom to a more inquiry-based environment.

Teachers were asked whether or not there were any challenges that would prevent them from implementing the 5E Lesson Plan Model in the middle of the school year. The new teachers were greatly concerned about classroom management and discipline while the veteran teacher and the master teacher were concerned about giving the students too much control in the classroom (see Table 4).

Table 4: Teacher Concerns about Implement the New Model

Teacher	Concerns
New Teacher Concerns	-Classroom Management (off task students) -Not comfortable with allowing students much movement in the classroom. -The students do not work well in groups. -Lower level students will not do well.
Other Concerns	-There is not time to do this type of activity. -We need to prepare for standardized tests. -I am afraid to give students that much control in the classroom.

To help the new teachers with classroom management, the group decided to develop a list of routines and procedures that should be found in all math classes at West St. John High School

(see Table 5). The teachers agreed that in order to make sure the new plan was implemented correctly there needed to be a set of norms all teachers followed.

Table 5: Classroom Routines and Procedures

#	Procedure/Activity	Description
1	Do Now	-Teacher made ACT practice sets. -No more than 10 minutes.
2	Review Homework/Scan AM Assignments	-No more than 10 minutes.
3	5E Lesson Activity	-Student Engagement activity for about 60 minutes
4	Learning Logs/ Reflection/Exit Tickets	5 to 10 minutes

We agreed that activities 1, 2 and 4 should be completed each time the class meets. Student engagement would occur in activity 3 during the middle of the classroom for about 60 minutes when students were not being formally assessed. Teachers used one of the sample activities in the 5E Lesson Plan format they received in Phase 1 or created their own 5E Lesson Plan during the 60 minutes of student engagement time. The first 20 minutes and the last 10 minutes of class were not optional; since we agreed that these routines must be consistent in all math classes at the school.

Phase 1 provided the teachers with the resources and routines needed to help facilitate student engagement in the classroom. The next phase of the professional development package required teachers to implement the strategies in their classroom with their students.

4.2 Phase 2: Classroom Implementation

In Phase 2 of the professional development package, teachers were required to implement at least one inquiry-based activity a week and use the 5E lesson plan model to plan that activity. In addition to implementing the activity, teachers were required to reflect on their students' level of engagement during the activity.

At the end of each activity, each teacher replied to the questions referring to the students' attitudes and behaviors about the inquiry-based activity.

(1) What was the students' level of involvement in the activity? (high or low)
(2) How did the students demonstrate understanding of the lesson objectives?
(3) How did the students react to your role as the facilitator?
(4) Were there any classroom management issues? If so, how did you correct them?
(5) Would you use this lesson in the future? If so, what could be done to improve this lesson?

In geometry, students completed the lesson Translating Transformations in Geometry (Appendix C.1). In this lesson, students developed conjectures for rotating, translating and reflecting a figure in the coordinate plane about the origin and about the line $y = x$. The teacher noticed that some students had a difficult time staying on task while working in a group, so it was important that the groups were monitored constantly. She constantly asked questions of each student to make sure the students were on task. She also noticed that many more students were motivated to complete the assignment because they were actually doing the work instead of just copying notes from the board. While the students seemed to understand translating a figure, some students still had a difficult time with rotating a figure during the Explore part of the activity. It was during the Explanation and the Elaboration parts of the plan that the teacher was able to help the students understand rotation a little better. This teacher's responses to the reflection questions are listed below.

Class Geometry Activity Translating Transformations in Geometry

(1) What was the students' level of involvement in the activity? (high or low)
The students' overall level of involvement was high. In addition to the role of facilitator, I had to make sure I reviewed key terms with students and question the students to ensure they were on task in their groups.
(2) How did the students demonstrate understanding of the lesson objectives?
Students created their own figures, completed two different transformations and then asked another student to undo the transformation.
(3) How did the students react to your role as the facilitator?
The students were apprehensive at first working with me as the facilitator.
(4) Were there any classroom management issues? If so, how did you correct them?
No management issues.
(5) Would you use this lesson in the future? If so, what could be done to improve this lesson?
Yes, I would use this activity in a future lesson.

In Algebra I, the Barbie Bungee (Appendix C.3) activity was used to help students develop the line of best fit and to write the equation of lines. The class began the Engagement section of the lesson plan by watching a short video about Bungee Jumping. After watching the video students were asked the following question: "Do you think the length of the cord and the size of a person matters when bungee jumping?" The males in the class were given a Ken doll and the females in the class were given a Barbie doll. Students then began working on the Exploration part of the lesson by determining the number of rubber bands Barbie and Ken needed to safely jump from the assigned height, constructing tables and graphs and developing conjectures based on their observations. In Explanation section of the lesson, students were given different height restrictions and a limited number of rubber bands. They developed conjectures based on whether or not the dolls would safely be able to jump, given the restrictions. In the Elaboration section of the lesson plan, the teacher cleared up any misconceptions about graphing the line of best fit and the slope and y-intercept. The purpose of the lesson was for the students to gather real-world data, construct a scatter plot using this data then write the equation of the line of best fit from that data. While some students were able to gather the data and graph the points, many students had a difficult time writing the equation of the line of best fit for their data. It was at that time the teacher decided to explain to the students what a line of best fit is and how the line of best fit can be determined. She felt that the level of the students was too low to have them struggle to determine the line of best fit themselves. The students had already discussed the slope and y-intercept in a previous lesson; however, they had a difficult time connecting the slope and y-intercept with this activity. The teacher's reflection on the lesson is below.

Class Algebra I Activity Barbie Bungee

(1) What was the students' level of involvement in the activity? (high or low)
The students were excited to use a different activity instead of just taking notes.
(2) How did the students demonstrate understanding of the lesson objectives?
Students were given 5 scatter plots and asked to determine equation of the line of best fit and compare the slopes and y-intercepts of each.
(3) How did the students react to your role as the facilitator?
At first the students did not want to complete the activity since I was not guiding them throughout the entire activity. They were resistant at first.
(4) Were there any classroom management issues? If so, how did you correct them?
Yes, this class is very vocal and loves to talk. I had to redirect several groups throughout the activity. There were some instructional time lost due to this.
(5) Would you use this lesson in the future? If so, what could be done to improve this lesson?
Yes, I would. I would organize the groups better due to the large number of management issues.

In another geometry activity, students were required to investigate the relationship between the sides and angles in a triangle to explore Triangle Inequality. This activity was taken from the Illuminations website. In this activity students used spaghetti, a ruler and a protractor to determine the relationship between the sides and angles of a triangle. Before the activity, the teacher reviewed the Triangle Angle Sum Theorem and inequalities with the students. Students then were then placed in groups, and given directions to answer teacher made questions and develop their own conjectures. The geometry teacher felt that the students' level of involvement in this activity was very high since it was hands on and tangible. The students demonstrated an understanding of the lesson objectives by writing their own conjectures and creating their own questions to include examples of side lengths that were triangles and some that were not. At first, the students were a little hesitant about the teacher's role as facilitator; however, with the detailed directions and guided questions included in the activity, they were able to complete the task. Management issues were at a minimum since the teacher facilitated the activity. This was

an overall great activity to complete with the students; however, in the future the teacher stated that she would include more real-world type of questions. The teacher reflection on the lesson is listed below.

Class Geometry Activity Triangle Inequality Theorem

(1) What was the students' level of involvement in the activity? (high or low)
Student level of involvement was high.
(2) How did the students demonstrate understanding of the lesson objectives?
At the end of the lesson, students completed a short independent quiz on triangle inequality.
(3) How did the students react to your role as the facilitator?
The students were able to complete the activity with me in the role of the facilitator.
(4) Were there any classroom management issues? If so, how did you correct them?
No, there were no classroom management issues. Routines and expectations were explained in an earlier lesson.
(5) Would you use this lesson in the future? If so, what could be done to improve this lesson?
Yes.

Overall, the teachers stated that the activities did increase student engagement and that they would the lessons in the future in their classrooms. They observed that the honors students needed little assistance, but the 5E lesson plan method when used with the students in traditional classes needed to written in a different format to provide them with more support from the teacher. The teaches observed many of the students who were at a lower math level struggling with the material and many of them wanted to give up and just wait from the answer.

The implementation of the 5E Lesson Plan method began with three math teachers; however, the veteran teacher was unable to implement the plan because she took a medical sabbatical from work. The plan had to continue with the two new teachers in the department.

Phase 2 involved the teachers implementing the strategies and using the activities and routines discussed in the initial presentation they attended in Phase 1. In Phase 2, teachers were able to facilitate the activities and observe students working together with their groups to arrive at their own conclusions. Teachers felt that while the activities were a great way of engaging all students in the classroom, it is imperative that students are not left on their own trying to struggle through to do the work. All of the activities required the teachers to review some prior skills students should have learned to ensure students were successful.

4.3 Phase 3: Meetings and Results

The professional development was designed to continue throughout the entire semester, from September to December. We first began with an initial meeting attended by the teachers in the department and the school's master teacher. After the meeting, the teachers were required to change the culture of their classrooms by first implementing the routines and procedures discussed in the meeting. Teachers participating in the professional development were required to meet biweekly; however due to school scheduling conflicts and other teacher responsibilities, the teachers met once a month to discuss their progress. A summary of each meeting is listed below (Table 6).

Table 6: Summary of Teacher Meetings

Date	Time	Subject/ Teacher	Discussion
9/10/2012	2:20-3:20	Algebra I-2 Teachers, Geometry-1 Teacher, Master Teacher, Asst. Principal	Initial professional development presentation to discuss new strategies and classroom routines.
9/21/2012	2:30-3:30	Algebra I-1, Geometry-1, Master Teacher, Asst. Principal	-Both teachers implemented classroom routines and used one task. -In algebra, the bungee jump activity was used with the honors class and in geometry, the transformation activity was completed. -Students were hesitant to begin the activity without the teacher having sole control of the classroom; however, with assistance from the teacher, they were able to begin the lesson. -Management was an issue in the Algebra class so the teacher asked for additional support with discipline from administration when completing activities such as these in the classroom. -It is important that prior skills are reviewed with the students to ensure success with the activity.
10/14/2012	2:30-3:30	Algebra I-1, Geometry-1, Master Teacher, Asst. Principal	-The geometry teacher completed one an activity involving Triangle Inequality with her tradition and honors students. The teacher had to review with the tradition students inequalities from algebra and The Triangle Angle Sum Theorem; while the honors class had prior knowledge of both of these. -The Algebra teacher continued to have issues with discipline in her classroom and was placed on an intensive assistance plan to help with classroom management; therefore, the inquiry-based lessons were not as effective in her classroom due to the large number of discipline issues.
11/12/2012	2:30-3:30	Geometry-1, Master Teacher, Asst. Principal	-In geometry, students completed an activity called Diagonals in Quadrilaterals. Students worked in groups. In this activity, students knew what to expect since they completed this type of activity before. –The teacher reported that the students did have trouble explaining their reasoning given the different conditions. -The teacher provided the students with more assistance and reviewed terms such as perpendicular lines and the names of different types of quadrilaterals.

The teachers felt that before any type of strategy could be implemented, classroom routines should be established and modeled for the students. If the routines are not established, then classroom management becomes an issue; thereby, making it difficult for student learning to occur. This has been my experience as a classroom teacher for over 17 years. Once management is under control in the classroom, an inquiry-based strategies can be implemented.

The purpose of the professional development package was to help teachers become proficient in Domain 3c of the Louisiana Compass Teacher Evaluation Rubric. While one of the teachers did have success with the activities presented in the initial presentation, the other teacher was not very successful. Support in the form of bi-weekly observations by school administrators along with immediate feedback would have helped this teacher implement an effective classroom management policy. Research has shown that with support teachers can become effective if the support is given.

Using the 5E lesson plan model helped facilitate an environment where inquiry-based learning is constant. Both teachers stated that the lesson plan helped to guide them and served as a tool that allowed them to plan an effective lesson allowing them to foresee what the students would be doing during each phase of the lesson. Although the lesson plan was a great tool to assist with planning for instruction, it was not a solution for inadequate classroom management skills.

It was difficult to determine the effect the strategies presented in the initial presentation had an effect on student engagement in the Algebra class, since so many students had behavior issues. In the geometry class, students understood the routines and were aware of the consequences if they broke a rule. The culture of this class changed and students worked together without the fear of failing.

As I reflect on the progress or lack of progress of the teachers who participated in this course of professional development, I realized that they would have performed even better if they both were provided with even more support. Although we discussed the students' progress during our monthly meetings, the teachers would have been more effective if more observations had been conducted with immediate feedback about the observation. Teachers should have been able to visit other teachers to observe them using inquiry-based activities with their students. In their book, *"The Teaching Gap",* Stigler and Heibert (p.152, 1999) put forth the idea that teachers who are given the opportunity to work together and watch each other teach may imagine new possibilities for their own teaching and cause them to improve their methods of instruction. It is evident from my discussions with the teachers that more progress would have been made if they were provided with more support.

As a result of this professional development package, school administrators implemented the 5E lesson plan model to be used as the school's lesson plan template for all teachers. The goal of the school administrators was to provide teachers with a tool to assist them with increasing student engagement in the classroom. At the conclusion of this professional development package, all teachers were using this template.

CHAPTER 5: CONCLUDING THOUGHTS

I began this thesis as an Assistant Principal working as the instructional leader to teachers in the math department. My goal was to help the teachers increase the level of student engagement in their classroom. This thesis was not intended to determine whether or not student achievement increased as a result of increasing student engagement in the classroom, rather, it was intended to give teachers a tool to help them increase student engagement and sample lessons they can use in their classrooms with their students.

In an article from the National Association of Elementary School Principals publication, instructional leaders are referred to as instructional resources with knowledge on effective instructional practices and current trends in education (Jenkins, 2009). As an instructional leader to the math department, my job was to observe teachers, facilitate discussions, provide additional support to teachers in areas they are deficient in and empower teachers so that they themselves can implement effective instructional strategies. After observing the math teachers in my department, it was evident from their scores on the Domain 3c (the student engagement component) that everyone needed assistance in this area.

After reading countless educational articles, meetings with administration and observing student behavior and teachers in the classroom. I realized I needed a strategy or tool that would help students become mathematical thinkers who were confident about their work and were not afraid to explore the material without constant prompting from the teacher. My goal was to work with the teachers to create a classroom culture of high expectations that was student-centered where routines and procedures existed so that all students were able to be successful. I needed to design a professional development focused on strategies, tools and activities all teachers could implement in their classrooms.

The quest of finding resources for the professional development was guided by the 8 Standards for Mathematical Practice. The standards are what all mathematics teachers should try to develop in all of their students at all levels. Along with the standards, I also used the teacher's evaluation rubric to help develop the focus for this professional development. I began extremely interested in inquiry-based learning. When implemented effectively in the classroom students are engaged and learning takes place. As my research continued into the topic or inquiry-based learning, I became familiar with the 5E lesson plan model that is often used by science teachers to help students conduct experiments. I now had a method teachers could use and a tool that would assist them in planning the lesson. A professional development was then designed to assist the teachers.

My plan was to present teachers with examples of how inquiry-based learning is used in the math classroom and give them examples of lesson plans written using the 5E lesson plan model. During the presentation, to the teachers, I realized that we also had to establish routines and procedures to ensure there was effective classroom management to allow this new type of method to be effective with the students. A professional development package was designed to provide the teachers with support as they tried to change their classroom culture to an inquiry-based learning environment to increase student engagement.

As a result of participating in this professional development, the teachers' classroom instruction did improve. Both first year teachers did improve in the Engaging Students in Instruction component of the Compass Teacher Evaluation Rubric. While one of the teachers score "Highly Effective", the other teacher scored between "Emerging and Proficient". This indicated that we still had some work to do to help this teacher achieve a rating of "Highly Effective" on this component.

At the end of the work on this thesis, my role in the school district changed. I now am in the role of Elementary school principal. Now that I am a principal, based on my experiences in this professional development at the high school, I now realize how important that the teachers begin engaging students in the classroom using the expectations listed in the Louisiana Compass Teacher Evaluation Rubric. Having worked as a high school teacher and administrator, it is my belief that if elementary and middle school teachers begin requiring students to "speak" and "think" about the mathematics they are completing in their classrooms they will develop stronger mathematic students at an early age. Then when students move up to the high school level, students would be familiar with the teachers working in the role as a facilitator.

As the instructional leader of the entire school, I realized that teachers will only become better at increasing student engagement if they are provided with support from administration in the form of observations and immediate feedback in addition to professional development. The professional development must be ongoing and teachers should be allowed to collaborate with one another frequently, not just once a month.

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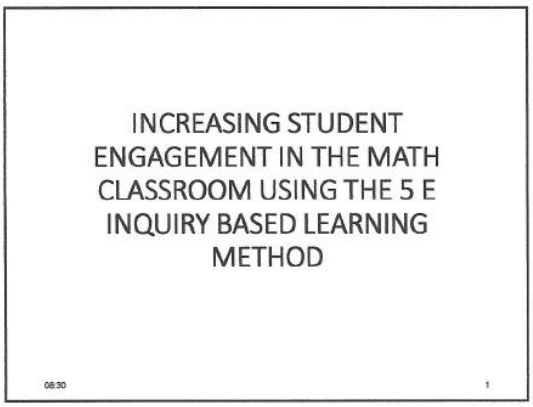
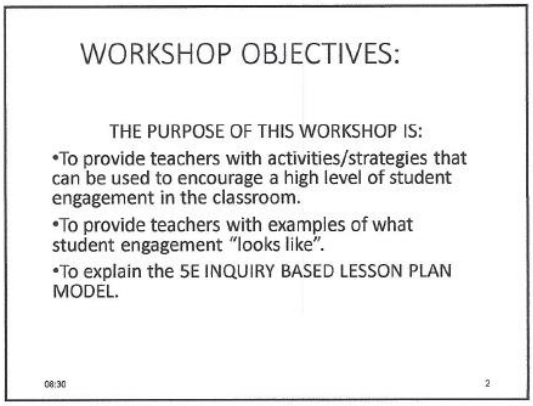
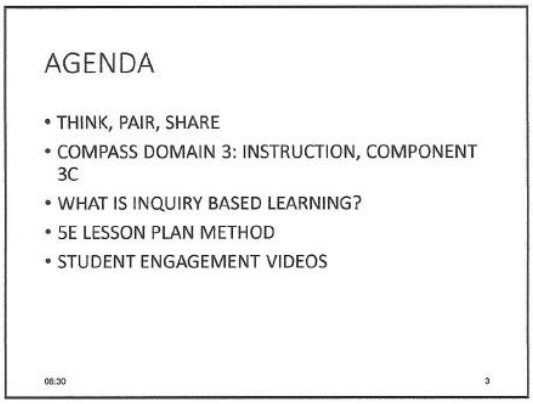
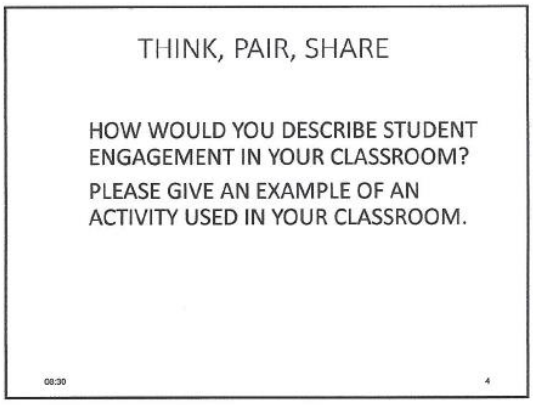
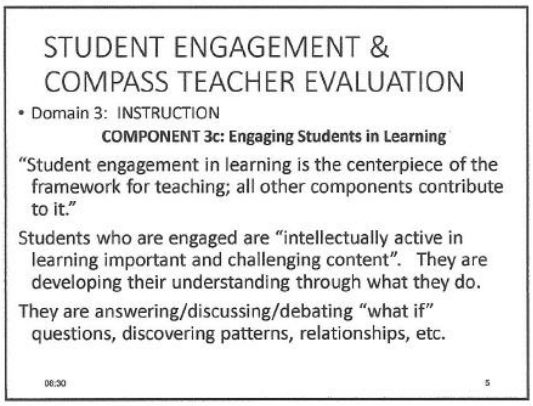
APPENDIX A: PROFESSIONAL DEVELOPMENT INITIAL PRESENTATION

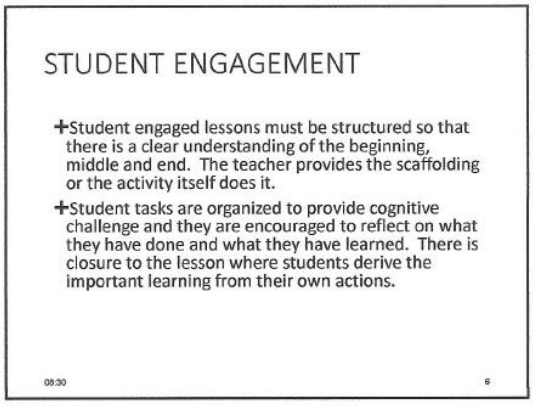












COMPONENTS OF DOMAIN 3C

- ACTIVITIES AND ASSIGNMENTS THAT ENABLE STUDENT ENGAGEMENT
- GROUPING /PAIRING OF STUDENTS
- INSTRUCTIONAL MATERIALS & RESOURCES
- STRUCTURE AND PACING

DOMAIN 3C: Engaging Students in Learning

KEY indicators of this practice, which include:

- All students are intellectually engaged in challenging content, through well-designed learning tasks, and suitable scaffolding by the teacher, and fully aligned with the instructional outcomes;
- There is evidence of some student initiation of inquiry, and student contributions to the exploration of important content;
- The pacing of the lesson provides students the time needed to intellectually engage with and reflect upon their learning, and to consolidate their understanding.
- Students may have some choice in how they complete tasks and may serve as resources for one another.

WHAT IS NOT STUDENT ENGAGEMENT

+FILLING IN BLANKS ON A WORKSHEET
+PERFORMING A ROTE PROCEDURE
+COMPLETING SEVERAL PROBLEMS ON A WORKSHEET IN GROUPS OR PAIRS.

STUDENT ENGAGEMENT VIDEO 2

DIRECT INSTRUCTION METHOD

Discovering the Properties of Quadrilaterals via @teachingchannel

http://soa.li/eVI60ic

VIDEO 2 REFLECTION

- In the previous video, was the class more teacher centered or student centered?
- What was the level of student engagement in this video?
- What could the teacher have done to change the activity to encourage more student engagement?
- Design this lesson in a different format that would take most of the focus off of the teacher and place the teacher in the role of the facilitator.

STATIONS ACTIVITY

Using Stations to Explore Algebra Expressions via @teachingchannel http://soa.li/sEp5W5I

STATION ACTIVITY: Reflection

+How can students learn from each other?

+How can you use this activity with another math concept?

+How does this activity allow you to address any student learning gaps?

08:30 13

WHAT IS IBL?

- Inquiry based learning is student-centered.
- The focus is on questioning, critical thinking and problem solving in the classroom.
- When teachers provide the correct activities, IBL encourages students answer the question "what if". Students are encouraged to discuss and debate with one another about the topic.

08:30 14

ADVANTAGES OF IBL

- High level of student engagement.
- Teachers are able to address different learning styles
- Large amount of Collaborative Learning activities
- Builds critical thinking skills.

08:30 15

INQUIRY BASED CLASSROOM SETTING

+Group work
+Communicating skills
+Problem solving skills
+Connecting Mathematics
+Reasoning

08:30 16

DISADVANTAGES

- Instructor is no longer the nucleus of the classroom.
- Planning and Preparation is essential if IBL is implemented correctly.
- Classroom Routines & Procedures must be established before IBL can occur.
- Students are not familiar with an IBL classroom; they must be guided in communicating math with other students (learn to talk mathematically).

08:30 17

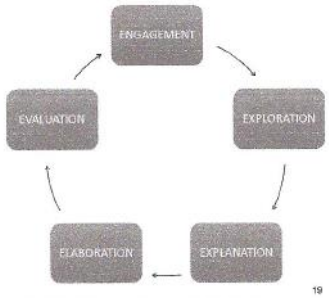
TEACHER'S ROLE IN AN IBL CLASSROOM

- Have classroom procedures and routines in place.
- Build a culture of respect in the classroom.
- Encourage student voice.
- Facilitate analysis development of ideas.
- Make students feel valued and let them know that everyone's opinion counts.
- Let students know that the answers don't necessarily rely on the teacher's authority or an answer key.

08:30 18

5E LESSON PLAN MODEL

- EACH STEP IS DESIGNED TO BULID ON THE PREVIOUS STEP.
  - ENGAGEMENT
  - EXPLORATION
  - EXPLANATION
  - ELABORATION
  - EVALUATION



08:30 19

STEP 1: ENGAGEMENT

- Motivate students for the lesson by building on prior knowledge. (THIS IS THE LESSON HOOK.)
- Teacher provides rules and directions for the rest of the lesson.
- (VIDEO; THINK, PAIR, SHARE; ETC.)

08:30 20

STEP 2: EXPLORATION

- These activities help students form their own conclusions.
- Teacher supervises and guides students.
- Teacher asks questions when needed.
- Inquiry action that allow students to ask questions such as "what if" and "why".
- Students investigate different possibilities to arrive at some conclusion.

08:30 21

STEP 3: EXPLANATION

- Students express what they've learned to the class/group.
- Students should be able to demonstrate their conceptual understanding.
- Teacher and sometimes other students clear up any misconceptions and add any additional information.
- Teachers can introduce the topic more directly in this phase.

08:30 22

STEP 4: ELABORATION

- Students extend the concepts they have learned and connect these to related subjects.
- Students practice their skills.
- May be the guided practice part of the lesson.
- Teacher can use this time to introduce new vocabulary.

08:30 23

STEP 5: EVALUATION

- Teachers determine how much students understood the lesson and what has been learned from the lesson.
- This is where students can assess their own learning.
- Encourages students to assess their understanding.
  - Writing summaries
  - Taking a quiz
  - Independent practice
  - Open ended questions (Why do you think...? How would you apply this to...? What do you know about the problem?

08:30 24

APPENDIX B: DOMAIN 3C: INSTRUCTION FROM THE LOUISIANA COMPASS TEACHER EVALUATION RUBRIC

	Ineffective	Effective: Emerging	Effective: Proficient	Highly Effective
3c: Engaging students in learning	The learning tasks and activities, materials, resources, instructional groups and technology are poorly aligned with the instructional outcomes, or require only rote responses. The pace of the lesson is too slow or rushed. Few students are intellectually engaged or interested.	The learning tasks or prompts are partially aligned with the instructional outcomes but require only minimal thinking by students, allowing most students to be passive or merely compliant. The pacing of the lesson may not provide students the time needed to be intellectually engaged.	The learning tasks and activities are aligned with the instructional outcomes and are designed to challenge student thinking, resulting in active intellectual engagement by most students with important and challenging content, and with teacher scaffolding to support that engagement. The pacing of the lesson is appropriate, providing most students the time needed to be intellectually engaged.	Virtually all students are intellectually engaged in challenging content, through welldesigned learning tasks, and suitable scaffolding by the teacher, and fully aligned with the instructional outcomes. In addition, there is evidence of some student initiation of inquiry, and student contributions to the exploration of important content. The pacing of the lesson provides students the time needed to intellectually engage with and reflect upon their learning, and to consolidate their understanding. Students may have some choice in how they complete tasks and may serve as resources for one another.

	Ineffective	Effective: Emerging	Effective: Proficient	Highly Effective
Critical Attributes	• Few students are intellectually engaged in the lesson. • Learning tasks require only recall or have a single correct response or method. • The materials used ask students only to perform rote tasks. • Only one type of instructional group is used (whole group, small groups) when variety would better serve the instructional purpose. • Instructional materials used are unsuitable to the lesson and/or the students. • The lesson drags, or is rushed.	• Some students are intellectually engaged in the lesson. • Learning tasks are a mix of those requiring thinking and recall. • Student engagement with the content is largely passive, learning primarily facts or procedures. • Students have no choice in how they complete tasks. • The teacher uses different instructional groupings; these are partially successful in achieving the lesson objectives. • The materials and resources are partially aligned to the lesson objectives, only some of them demanding student thinking. • The pacing of the lesson is uneven; suitable in parts, but rushed or dragging in others.	• Most students are intellectually engaged in the lesson. • Learning tasks have multiple correct responses or approaches and/or demand higher order thinking. • Students have some choice in how they complete learning tasks. • There is a mix of different types of groupings, suitable to the lesson objectives. • Materials and resources support the learning goals and require intellectual engagement, as appropriate. • The pacing of the lesson provides students the time needed to be intellectually engaged.	In addition to the characteristics of "proficient," • Virtually all students are highly engaged in the lesson. • Students take initiative to modify a learning task to make it more meaningful or relevant to their needs. • Students suggest modifications to the grouping patterns used. • Students have extensive choice in how they complete tasks. • Students suggest modifications or additions to the materials being used. • Students have an opportunity for reflection and closure on the lesson to consolidate their understanding.

APPENDIX C: SAMPLE LESSON PLANS

Lesson C.1 Translating Transformations in Geometry

	INVESTIGATING TRANSFORMATIONS (Lesson from Louisiana Teacher-to-Teacher Geometry Lesson Plan)
Materials:	Graph paper, Data Collection Worksheet, Pencils, Optional materials: Graphing Calculator
GLE/CCSS	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. (CCSS: G-CO.4) Develop and apply coordinate rules for transformations and reflections of geometric figures. (GLE: M.10.14; CCSS: G-CO.2, G-CO.5)
Lesson Objective(s)	1. The students will recognize transformations by each of two terms. 2. The students will visualize the movement of images on the coordinate plane. 3. The students will identify points of the image on the coordinate plane. 4. The student will organize data in the transformation of various images. 5. The student will establish numerical patterns in the transformation of various images.
Bell Work	ACT PRACTICE SETS
ENGAGEMENT • Describe how the teacher will capture students' interest.	Remind students what has been learned in previous lessons that will be pertinent to this lesson and/or have them begin to think about the words and ideas of this lesson. Can be done as a whole class discussion or as a Think, Pair, Share Activity. . Can someone tell me where you might see a reflection in everyday life? . Can anyone tell me what it means to rotate an object? . Can anyone guess what it might mean to translate an object?
EXPLORATION • Describe what hands-on/minds-on activities students will be doing. • List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration	-In groups of 3, students will complete the transformations explore activity. Each student should be assigned a role: Translation, Rotation, Reflection. -Students will complete the tasks to rotate, reflect and translate the figure then write a conjecture based on the pattern observed after each transformation. -Students should observe a pattern after each transformation is completed.
EXPLANATION • What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?	-After completing their worksheet in groups, the class will return to a whole group discussion and each group will present their solutions.
ELABORATION • Describe how students will develop a more sophisticated understanding of the concept. • What vocabulary will be introduced and how will it	- Teacher will review lesson vocabulary with students. Students will record vocabulary in their journals/notebooks. -Clear up any misconceptions with the definitions. -Provide students with another shape to complete as a class to test their conjectures.

connect to students' observations?	
EVALUATION • How will students demonstrate that they have achieved the lesson objective?	-Students will be given a set of problems that will require them to translate, rotate and reflect figures. -Students must use a real-world figure and translate, rotate and reflect the figure about the origin and about the line y=x. Have each student choose a figure and apply 2 transformations to it (noting what he or she did). Then have students change places and try to determine how to undo each transformation.

Lesson C.2 Diagonals to Quadrilaterals

	DIAGONALS TO QUADRILATERALS
Materials:	Think of a quadrilateral worksheet, Computers with internet access, Markers. Whiteboards, Diagonals and Quadrilaterals Activity Sheet, Triangle Time, Access to websites: http://illuminations.nctm.org/ActivityDetail.aspx?ID=148 (Diagonals to Quad I & II Tools)
GLE/CCSS	GLE 9 and 19
Lesson Objective(s)	Students will: -Identify the types of quadrilateral possible, based on information about the diagonals. -Determine the characteristics of a polygon based on relationships among components of the polygon.
BELL WORK	ACT PRACTICE SETS 1 & 2
ENGAGEMENT • Describe how the teacher will capture students' interest.	Think of a Quadrilateral Worksheet. Students will think of a quadrilateral they can construct from two diagonals that are perpendicular to each other, sketch it then describe the quadrilateral sketched. Other possible questions: Describe the properties for this diagonal. Do the diagonals bisect each other? Are there other possible ways the diagonals could intersect?
EXPLORATION • Describe what hands-on/minds-on activities students will be doing. • List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration	Students will use a program that shows how diagonals are related to their quadrilaterals. In groups of 3 or 4 students will explore sketches of different diagonals, use an applet to construct quadrilaterals with the types of diagonals in the sketches, then explain their reasoning for choosing the quadrilateral. It is the goal for students to determine the characteristics of different quadrilaterals by observing the construction of the diagonals.
EXPLANATION • What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?	Teacher will prompt students to explore the effects of adding conditions to the diagonals. After completing the exploration in groups, the students will return to a whole-group setting and present their groups' answers. Other students are responsible questioning the groups while comparing their work with the groups. Teacher will probe students for responses about their conclusions. (How do you know the quadrilateral is a rhombus?)
ELABORATION • Describe how students will develop a more sophisticated understanding of the concept. • What vocabulary will be introduced and how will it connect to students' observations?	The teacher will put Diagonals and Quadrilaterals on the SmartBoard, while students have a copy on their desks. As students describe their finds, the results will be recorded on the chart. Remind students that some conditions will overlap. The teacher will present a summary of the characteristics of the quadrilaterals. *Questions for students:* Why does it make sense that knowing the diagonals of a quadrilateral are perpendicular is not sufficient to show that the quadrilateral is a rhombus? Explain using diagonals why a square is both a rhombus and a rectangle. Explain using diagonals why a square is always a rhombus but a rhombus is not always a square.
EVALUATION • How will students demonstrate that they have achieved the lesson objective?	• :Journal Prompt: The conditions we place on the diagonals of a quadrilateral tell us the type(s) of quadrilateral we have. Describe the types of conditions we might put on diagonals of a quadrilateral. Explain how these conditions lead us to particular types of quadrilaterals. • The diagonals of quadrilateral MATH are perpendicular and they bisect each other. What type of quadrilateral is MATH? Answer in words and draw one or more sketches to illustrate your answer.

Lesson C.3 Barbie Bungee

	BARBIE BUNGEE
Materials:	Rubber bands (all the same size and type) (15-20 for each group), Yardsticks or measuring tapes, masking tape, Barbie dolls or similar dolls Barbie Bungee Activity Sheet, Optional: Graphing Calculator or access to the internet
GLE/CCSS	
Lesson Objective(s)	Students will: -Collect data using a rubber bad bungee cord and a Barbie doll. -Use the data collected to construct a scatterplot and generate a line of best fit. -Predict how many rubber bands are needed for Barbie to safely jump from a given distance.
Bell Work	ACT PRACTICE SETS (6 questions)
ENGAGEMENT • Describe how the teacher will capture students' interest.	Think Pair Share Question: Do you think the length of the cord and the size of a person matters when bungee jumping? Would it be smart to lie about your height or weight? -Students will watch a short Bungee Jumping Video (2 minutes
EXPLORATION • Describe what hands-on/minds-on activities students will be doing. • List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration	-Using the Barbie Bungee activity packet, in groups of 3 or 4 students will determine the number of rubber bands that should be used to give Barbie a safe jump from the assigned height. -After conducting the experiment, students will create a graph of the data on paper and using internet resources and complete the activity sheet based on their observations. -Students will then test their conjectures outside.
EXPLANATION • What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?	Possible Teacher questions for students. -How many rubber bands are needed for Barbie to safely jump from a height of 400 cm? (Encourage students to use their line of best fit.) -What is the minimum height from which Barbie should jump if 25 rubber band are used? -How do you think the type and width of the rubber band might affect the results? Do you think age of the rubber bands would affect the results--that is, what would happen if you used older rubber bands? -If some weight were added to Barbie, would you need to use more or fewer rubber bands to achieve the same results? Conjecture a relationship between the amount of weight added and the change in the number of rubber bands needed.
ELABORATION • Describe how students will develop a more sophisticated understanding of the concept. • What vocabulary will be introduced and how will it connect to students' observations?	-Students will present their findings to the class along with their line of best fit and their equation. -Teacher will clear up any misconceptions and allow students to question their peers. -Discuss the meaning of the slope and y-intercept within the context of this problem.
EVALUATION • How will students demonstrate that they have achieved the lesson objective?	• Students will complete a reflection to explain what happens to a line when the slope or y-intercept changes. • Students will be given 5 scatter plots. They will determine the line of best fit for each problem and explain the significance of the slope and the y-intercept of each.

Lesson C.4 Simplifying Expressions

	Simplifying Expressions
Materials:	-Index Cards labeled as such: 1 – 8, a to 8a, b to 8b, and so on for c, a^2, b^2, and c^2. One set of cards for each group. -Log Sheet to record the Expressions.
GLE/CCSS	
Lesson Objective(s)	Students will: -Simplify algebraic expressions by combining like terms.
Bell Work	ACT PRACTICE SETS (6 questions)
ENGAGEMENT • Describe how the teacher will capture students' interest.	-Reflection Questions: What is an algebraic expression? Give an example of an algebraic expression? -What are like terms? How do you know they are alike? -How do we know if an expression is simplified?
EXPLORATION • Describe what hands-on/minds-on activities students will be doing. • List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration	-Divide students into groups of 4. -Each group member will receive 7 index cards. -The rest of the cards are placed in a pile face down. -The first card is flipped and players try to make a group of 3 or 4 cards that are like terms. For example if a student has 2a and a in their hand and a 3a is flipped from the deck, they have a match and would place those cards face up on their desk. -The recorder in the group then writes the expression down on their log sheet. -After making a match, then throw one card away from your hand. Other members in the group can use this card if they need the card, then repeat the process. -If the card thrown is not needed by anyone in the group, then the next card is flipped from the pile of cards face down and the game resumes with everyone trying to make a match. -The first person without cards wins the game.
EXPLANATION • What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?	-The teacher will explain to the students that what they can take the like terms and combine them. This is a part of simplifying expressions. -Each group will present 3 of their matches to the class. -Volunteers would then simplify the expressions listed on the board.
ELABORATION • Describe how students will develop a more sophisticated understanding of the concept. • What vocabulary will be introduced and how will it connect to students' observations?	- Students will be given groups of examples that illustrate other methods for simplifying expressions. These examples will focus on the laws of exponents. The students will use the examples to write their own rules for simplifying the expressions and present their rules to the class. Example: (Students will be given problem sets similar to the set below and ask to create a rule.) $(a^2)(a^4) = a^6$ $a^3/a^2 = a$ $(2a^4)(5a^2) = 10a^6$
EVALUATION • How will students demonstrate that they have achieved the lesson objective?	-Students will write an algebraic expression containing at least 5 terms, then simplify the expression. -Students will create their own examples of each law of exponents and simplify.

VITA

Chantell Holloway Walker, a native of Louisiana received her bachelor's degree from Nicholls State University in 1992 in Business Administration. It was after graduating from Nicholls State University that her interest in education grew. In 1994 she entered the alternative certification program as Southern University in New Orleans in addition to teaching high school math. In 2007, while still teaching high school mathematics, she received her Master's in Educational Administration and Leadership from University of Phoenix. She entered the Masters of Natural Sciences program at Louisiana State University in the summer of 2011. She will receive a second master's degree in May 2015 and plans to begin work on her doctorate upon graduation.