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TE 861c
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Final Action Research Plan

Research Question:

How does the introduction of inquiry-based activities improve students' summative & formative assessments?

Introduction

Students struggle in math. Those that struggle, and even those that don't struggle, often have low confidence in the abilities in math. In many mathematics classrooms, often times even in my own classroom, students are given notes/instruction/examples on how to do something, asked to repeat the process over and over until they can do the same process on their own and apply that process to similar situations. This way of teaching mathematics has been going on for years. If something is working, why fix it? But is it really working? Are students able to apply their knowledge to similar situations? Are students able to recall concepts after a week, a month, a year, etc? Is this really the best way for ALL students to learn?

As I was going through my first year of a full-time teaching position, I questioned how to best educate my students. I began to feel that students need to not always be told what to do, but to sometimes figure it out on their own or with other students. These thoughts and questions led me to want to research the use of inquiry-based activities in my classroom. Would students improve their assessments by using more than one method of instruction? Would students be able to work through an inquiry-based activity to learn different concepts?

I want to use higher order cognitive tasks and inquiry activities in the classroom. I feel that my students are currently only recalling and applying information or procedures instead of using what they know to figure out how to do something new (inquiry). I do not feel that every lesson should be inquiry-based,

or hands-on, or integrate technology, etc; instead I feel that there should be a balance of inquiry-based lessons and non-inquiry-based lessons.

I would be able to research this in a few different ways. First of all, I plan to implement these activities on a small scale, so that I am not overwhelmed (Grimes, 2009). I would look at student responses to their learning (journal activities), formative assessments (homework, quick check-ins, "ticket out the door," notebook checks, and oral in-class questions) and summative assessments (weekly quizzes).

Since I am in a very small school, there is only one other math teacher. I teach completely different classes then the other teacher; so thus, I would be doing this individually. Although I will be doing this individually, I am often discussing what is going on in my classroom with the other math teacher and my mentor, so the action research would also be something that I would be discussing and bouncing ideas with them. I plan to document my ideas and observations in a double-sided journal. I think this method would allow me to quickly jot down ideas right after a lesson or acting of the research, and then go back to reflect.

Literature Review

I have found that many mathematics teachers have heard of or have seen the positive effects of hands-on or inquiry-based learning in the classroom. My colleague at Hillman High School often states that students learn best when they are actively engaged in their learning and when students can physically manipulate something in front of them. I (and many other teachers) would agree with these statements, but I have not put them to "test" in my own classroom, to see if there is a difference in student achievement, understanding and assessments when students are given an inquiry-based or hands-on approach to learning.

Through my literature review, I found that students "clearly preferred classrooms where they were actively involved in lessons" (Klinger & Vaughn, 1999, p. 32). Klinger & Vaughn also found that middle

school and high school student's hands-on experiments as "highly effective for promoting learning" (1999, p. 32). Even though this literature was more focused on students with disabilities in the classroom and students' perceptions of inclusion, it was encouraging to find that both learning disabled and non-learning disabled students found hands-on approaches to be the best learning environment. For my action research, I would like to also collect student responses on how effective they felt inquiry lessons were compared to non-inquiry lessons.

The use of manipulatives is one resource tool allowing students a hands-on approach. Students are able to use a wide range of manipulatives to learn anything from adding numbers to solving algebraic equations. Students "indicated that manipulatives helped them 'understand what it means to solve problems'" (Research Summary). Manipulatives are not only physical objects. Virtual manipulatives exist in which students can "interact in a virtual environment" (Research Summary). There are many computer-based, calculator-based and online programs that are available for use in the mathematics classroom in which students are able to investigate and manipulate a mathematical situation.

Courtney, Handwerk, & Rock (1999) performed a study on an inquiry-based math program called "Math Out of the Box" (MTB) with third, fourth and fifth graders. In this study they researched the "effect of an inquiry-based mathematics program on student achievement" (Courtney et al., 1999, p. 6). To clarify inquiry-based instruction to traditional instruction, they stated that in inquiry-based instruction the teacher is "viewed as a facilitator," the student is placed at "the core of the learning process, constructing knowledge through interaction with guided materials" and students learn through "acquisition of concepts and skills" (Courtney et al., 1999, p. 6-7). The study compared pre- and post-year assessments of students that were in MTB groups and those that were not in MTB groups. They found that "students who used MTB as a supplementary curriculum did somewhat better on the ETS assessment at the end of the year than students who did not use MTB" (Courtney et al., 1999, p. 11-12).

Although Courtney et al. (1999) found that students did better using an inquiry-based program, I would like to look at additional data sources to find the results of my research question. They only compared

one pre- and post- test that the students took, finding only a small increase in scores when comparing inquiry to non-inquiry. I feel that it would be more beneficial to look at assessments throughout the unit/year, daily checks on student understanding and also student responses to the effectiveness of inquiry lessons. Only looking at one test does not give a well rounded conclusion on the study.

Data Collection

I will use three sources of data to help answer my research question. I will collect student responses to learning (journals), student work (formative assessment), and student assessment grades (summative assessment).

Although student journals are not a regular aspect of my everyday classroom, Sagor (2000) suggests you can still use this method episodically. This is what I plan to do to check for student understanding. These journals will be short questions asking if students found the lesson to be useful, what may have been frustrating about the lesson, and if they feel they gained an understanding of the objective. These journal questions will be given after inquiry lessons and after some non-inquiry lessons. By asking students how well they felt they understood the concept (see Appendix A for example journal questions) and what they felt was useful/frustrating about the activity will allow me to see from a student's perspective. Knowing where students feel their understanding level is at after an inquiry or non-inquiry lesson will help me to improve the lesson in the future and see if the students feel that inquiry lessons improve their understanding of a concept.

Student work will be collected in the form of a notebook, "tickets out the door" and oral questions asked in class. I already have students keep a notebook that contains all bell ringers, notes, assignments and concept assessments throughout the semester; notebooks are collected on a weekly basis with occasional "surprise" checks. I can use this to gauge student understanding. I also will be doing "tickets out the door" which could be the journal (Appendix A) or it could be a quick question or two that if the students understood the lab, they would be able to answer. "Tickets out the door" is a short problem or

response question in which the students need to answer on a piece of paper and hand in before they are able to leave at the end of class. This allows a teacher to get immediate feedback on student understanding after a lesson or activity. Getting immediate feedback will help me to gain a perceptive of where the students understanding of a concept is after a lesson.

I will continue this year with the use of concept assessments (see Appendix B for example); this will allow me to chart student grades on concepts in which we did inquiry labs. I will be able to check for improvement of assessments from last year's grades. Concept assessments are given on a weekly basis. Concept assessments will give me a summative assessment of student understanding after inquiry-based lessons.

Data Analysis

I will look for improvement in formative assessments through student response journals and student work. I will collect student responses after inquiry-based and non-inquiry-based lessons. With student responses I will be able to find a percentage of the students who feel they have a good understanding of a concept in inquiry-based lessons vs. non-inquiry-based lessons. I will also be able to document student frustrations and what they found to be useful in the lessons for future improvement in both types of lessons. Although student feedback will be useful and beneficial, it is also important that I collect actual student work to check for student understanding. Student work will be collected through assignments and bell ringers in their notebooks, and "tickets out the door" for immediate feedback.

I will use concept assessments as a way to measure summative assessment improvements. I will be able to chart individual concepts in which inquiry-based activities were used to measure student development on concepts. I will also be able to compare how well students did during inquiry-based lessons to the same concept grades last year.

Timeline

During the first and second Marking Periods I will be introducing inquiry-based lessons/activities to my Algebra 1 classes only. If the first semester goes well in integrating these lessons, I will begin to use inquiry-based lessons in my other classes as well. The timeline for Marking Period 1 and 2 would be used for Marking Periods 3 and 4 for introducing inquiry-based lessons into my other classes.

Marking Period 1 (Algebra 1)

- Introduce 4-5 inquiry-based lessons/activities.
- Keep other lessons/activities same as last year.
- Collect student responses after all inquiry-based lessons and after 4-5 non-inquiry-based lessons. Thus students will turn in a student response about once a week.
- Chart average grades of concepts involving inquiry-based lessons.

Marking Period 2 (Algebra 1)

- If inquiry-based lessons go well during the first marking period, increase the number of inquiry-based lessons/activities.
- Continue to collect student responses to lessons. Collect after both inquiry-based lessons and non-inquiry-based lessons. Continue to average about one student response collect each week.
- Continue to chart grades of concepts involving inquiry-based lessons. Can compare charts to concept grades during the previous year.

Marking Period 3 and 4

- Algebra 1: Continue to use inquiry-based lessons, using them when I feel it is the best teaching strategy for a concept.
- Other classes: Follow the timeline for Marking Periods 1 and 2 to introduce inquiry-based lessons.

References

Courtney, Rosalea, Handwerk, Philip G., & Rock, JoAnn L. (May 2009). *Supplementing a Traditional Math Curriculum With an Inquiry-Based Program: A Pilot of Math Out of the Box*. from http://www.eric.ed.gov/PDFS/ED505581.pdf

Grimes, K. J., & Stevens, D. D. (2009). Glass, Bug, Mud. *Phi Delta Kappan*, *90*(9), 677-680.

Klinger, J. K., & Vaughn, S. (1999). *Students' perceptions of instruction in inclusion classrooms: Implications for students with learning disabilities*. Exceptional Children, 66, 23-37.

Research Summary - Manipulatives in Middle Grades Mathematics. (n.d.). . Retrieved July 20, 2010, from http://www.nmsa.org/Research/ResearchSummaries/Mathematics/tabid/1832/Default.aspx

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Appendix A

Name_____

Date_____

What did you find useful about this lesson?

What did you find frustrating about this lesson?

How would you rate your understanding of (*insert concept)*?

one being “I have no understanding on the concept” and five being “I could explain the concept to someone else I understand it so well!”

(circle rating) 1 2 3 4 5

Appendix B

Name_____

Date_____ Hour_____

Concept Numbers	1	2	3	4	5

SHOW ALL WORK FOR CREDIT!

1. Parallel Lines
   Write an equation of the line that is parallel to y = -2x + 1 and through point (1, -3).

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2. Perpendicular Lines

   Write an equation of the line that is perpendicular to $y=\frac{1}{3}x + 1$ and through point (1, 2).

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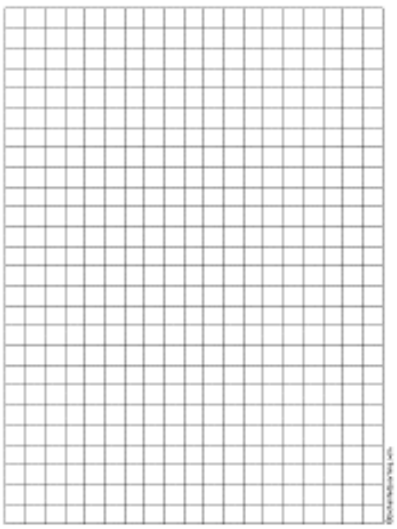
3. Absolute Value Graphs

   a. Graph

   $y = |x + 4| - 3$

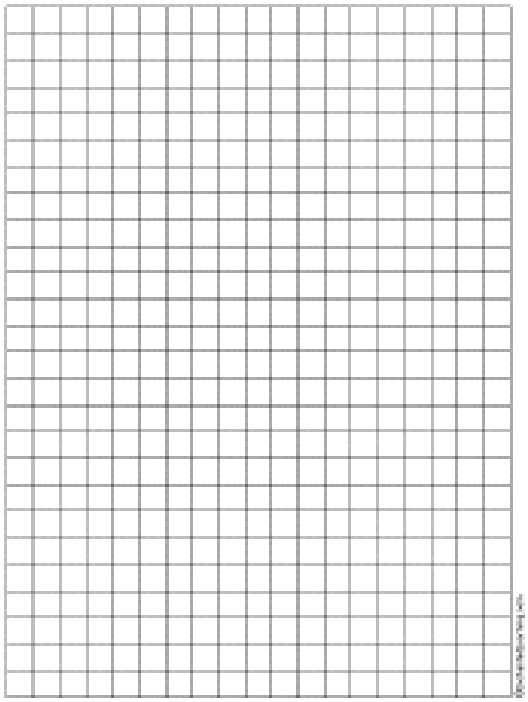


   b. Write an equation for a translation 5 units right and 2 units down.

4. Solve by Graphing

$y + 2x = -10$

$y = \frac{1}{4}x - 1$



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5. Solve by Substitution

$y + 2x = 5$

$2x + 2y = 6$