Student use of sequential writing to improve scores on constructed response items in math

Rachael Fellers

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Student Use of Sequential Writing to Improve Scores

On Constructed Response Items

In Math

By

Rachael Fellers

Action Research

Submitted in Partial Fulfillment of the

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2012
This action research has been approved for Cardinal Stritch University by

[Signature]

Date ___July, 2012______________
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Chapter 1

Introduction

According to recent data from the WINNS 2009 school year 50.4% of 5th grade students in Wisconsin with disabilities performed at or below basic in Mathematics on the Wisconsin Knowledge Content Examination (WKCE). That number improved by .1% to 50.3% during the 2010 school year. In Milwaukee Public schools during 2009, 69.5% of 5th grade students with special needs performed at or below basic and 68.6% in 2010. That is a difference of only .9%. These scores do not reflect the required growth that requires Wisconsin to be at 79% proficient by the 2011 school year. Federal law under the No Child Left Behind Act requires these yearly improvements. The consequences can lead to school closings and less funding.

Data is gathered each year. The WKCE, a norm-referenced test is administered to students usually in November and is what Adequate Yearly Progress (AYP) is based upon. All students are required to take this exam with the exception of the 1% of students with severe disabilities that are given the Wisconsin Alternative Assessment (WAA). This means that students with disabilities, regardless of ability, are required to take the WKCE at their grade level and not at their performance level. One area that students with special needs specifically struggle with is the constructed response section in math.

As the Milwaukee Public school system struggles to meet AYP it has become apparent that students with special needs struggle with providing an appropriate justification for their answers on constructed response questions on the WKCE.
With the addition of the Common Core State Standards, the focus from answering the question has now shifted to focusing on a student’s ability to problem solve, reason, communicate, and represent connections.

**Purpose of the Study**

The purpose of this study is to examine the use of graphic organizers and their effectiveness as a tool for students with special needs to express their mathematical thinking. I hypothesized that when provided with a sequential writing format, students would be able to more effectively communicate how they solved a constructed response question and the steps needed to do so. My research question was: Will the weekly use of a sequential writing process/graphic organizer improve constructed response scores on the WKCE assessments for students with special needs?

**Scope and Limitations**

The main limitation of this study is the low level of participation. Because of the high mobility rate among students in the Milwaukee Public Schools, there were students that came and left before the study could be completed and therefore could not be included. Also, there were many students that did not return a permission slip and could not be counted.

**Summary**

Schools are facing greater pressures than ever before. With the focus shifting to responding to interventions, before a student is considered for special education, teachers are required to use research-based interventions. They must demonstrate that they used best practices before a higher level of intervention takes place with the student. With the new criteria that teachers and students must work through, teachers are anxiously seeking
tools that meet the needs of their ever changing students and the ever-changing demands placed on them for performance.

In addition, the common core standards are requiring that students must also be able to do more than perform basic operations. They are being asked to justify an answer for which they don’t understand the why but only the how. With the assistance of academic tools like graphic organizers, students may organize their thinking where they might not otherwise have done so. Writing out each step taken to reach the outcome forces the student to self reflect on the why, and hopefully provide a clear explanation.
Chapter 2

Review of Literature

When provided with a format for responding to mathematical thinking, students are more likely to experience more confidence in their writing (Sousa, 2007). Students with disabilities often struggle with how or what is the right answer. Now, students are being asked to describe and communicate their conceptual understanding of the “how” or “the right answer.” Goeden (2002) and the National Reading Panel’s, 2000 research (as cited in Zollman, 2009) indicated that using a graphic organizer helps students to organize their ideas and improve their comprehension and communication skills. Sadly, many students with disabilities in math also struggle with reading and writing. When students communicate in math, a language they struggle with, asking them to translate math into the written English word can be very confusing. Joshiet et al., (2008) and Vilenius-Tuohimaa, Aunola, and Nurmi’s 2008 studies found that writing has been effective in improving reading comprehension and reading comprehension appears to be strongly correlated to mathematical problem solving ability (as cited by Verlaan, 2009). Specifically students with special needs thrive on learning strategies (Sousa, 2007).

Zollman (2009), designed a research project to improve student achievement in open- response problems. In this research he suggests that using graphic organizers helps students organize and clarify their thoughts in addition to “giving students a starting point for the problem solving process” (p.5). In addition, “using graphic organizers help the students and the teacher identify missing information or absent connections in one’s strategic thinking” (Ellis, 2004) as cited by Zollman (2009). Therefore writing is a critical component in expressing mathematical thinking. Zollman concluded that having
students write using graphic organizers helped students at various ability levels improve their overall mathematical communication.

The use of graphic organizers and using writing to explain mathematical thinking was also supported by Verlaan (2009). He explored several studies that support the benefits of writing in mathematics and specifically the use of graphic organizers. He stated, “students can make use of graphic organizers as scaffolding devices to develop written justifications for a wide variety of mathematical concepts as they explain problem solving procedures” (p.189). This particular method of organizing steps is also supported in his article. “Having students write the rule or step applicable to each part of the problem solving process reinforces the concepts they are trying to master” (p.191). Students are not just explaining the scorers and how they developed their conclusions; they are also explaining it to themselves.

In summary, writing in mathematics can be beneficial for both students and teachers. Writing helps to clarify one’s thinking, provide instant insight into a student’s train of thought, identify key elements that are missing or need more exploration. Also, writing helps improve communication. Finally, using sequential writing helps to reinforce the steps needed to solve a math problem. Therefore, this action research project was based on the assumption that writing will improve student’s overall mathematical communication.
Chapter 3

Methodology

Design
The study contained an identical pre–test and a post–test given to each student at this or her grade level. It was conducted with one group of students of mixed grade levels 5 and 6. This was a quantitative study designed to measure score improvement over time based on their responses from their constructed response questions.

Participants
My study included three 5th grade students and three 6th grade students all performing at or below a 3rd grade level according to their Individual Education Plans (IEP). Two of the six were female, 100% of participants received free and reduced lunch, were African American, and had been identified with an emotional/behavioral disorder.

Procedure
In my research, students used a sequential writing graphic organizer to organize the order in which they solved a problem. I modeled the sequential writing process using the graphic organizer every Monday for our problem of the week. I would choose one piece of work each week that we would evaluate as a class using the WKCE model. Over time, I invited students to lead the modeling on Monday’s for the week’s problem. I made a poster size copy of the graphic organizer and posted it in front of the classroom for students who easily lost their copies of the writing format and for additional visual support. In addition to providing multiple copies to students for practice. I also encouraged students to evaluate their own work and the work of their peers during independent work time.
During the modeling/guided practice phase, students were allowed to work together. The reason for allowing students to work together is that in their regular education setting, they are always grouped together. Providing this security and acknowledging this learning style helped students feel more supported. Each step was highlighted in a different color. Students were allowed to use different colors indicating the various steps they took. Accommodations also varied from extended time, scribing, use of manipulatives, and typing on the computer. Other considerations were taken into account according to student IEP’s.

**Materials**

Pre-test and posttests were taken from WKCE 2009. Problem of the weeks were taken from previous WKCE tests and Benchmark assessments taken from previously released Benchmark Assessments from the Milwaukee Math Partnership.

**Data Collection**

I administered a pretest using previously released WKCE constructed response questions in September. I scored them using the WKCE model. Every other week from October to December, I tracked student progress by providing a Constructed Response question from the Milwaukee Math Partnership program at increasingly difficulty levels using the rubric provided for that specific question. Finally, in January I administered a posttest to determine overall growth, scoring it using the WKCE rubric.

The following timeline was used in this study:

<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Pre-Test administered</td>
</tr>
<tr>
<td>Week 2</td>
<td>Model Sequential Writing using problem of the week</td>
</tr>
<tr>
<td>Week 3</td>
<td>Model Sequential Writing using problem of the week</td>
</tr>
<tr>
<td>Week 4</td>
<td>Model Sequential Writing using problem of the week</td>
</tr>
<tr>
<td>Week 5</td>
<td><strong>Benchmark assessment/ with group discussion and feedback</strong></td>
</tr>
<tr>
<td>Week</td>
<td>Activity</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Week 6</td>
<td>Model Sequential Writing using problem of the week</td>
</tr>
<tr>
<td>Week 7</td>
<td>Benchmark assessment/ with group discussion and feedback</td>
</tr>
<tr>
<td>Week 8</td>
<td>Model Sequential Writing using problem of the week with student support/instruction</td>
</tr>
<tr>
<td>Week 9</td>
<td>Benchmark assessment/ with group discussion and feedback</td>
</tr>
<tr>
<td>Week 10</td>
<td>Model Sequential Writing using problem of the week with student support/instruction</td>
</tr>
<tr>
<td>Week 11</td>
<td>Benchmark assessment/ with group discussion and feedback</td>
</tr>
<tr>
<td>Week 12</td>
<td>Student led instruction with guided support</td>
</tr>
<tr>
<td>Week 13</td>
<td>Benchmark assessment/ with group discussion and feedback</td>
</tr>
<tr>
<td>Week 14</td>
<td>Student led instruction with guided support</td>
</tr>
<tr>
<td>Week 15</td>
<td>Benchmark assessment/ with group discussion and feedback</td>
</tr>
<tr>
<td>Week 16</td>
<td>Student led instruction</td>
</tr>
<tr>
<td>Week 17</td>
<td>Post-Test administered</td>
</tr>
</tbody>
</table>
Chapter 4

Results

Table 1. Test Scores

<table>
<thead>
<tr>
<th>Student ID</th>
<th>Pre Test</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Test 5</th>
<th>Test 6</th>
<th>Post test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Student 2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Student 3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student 4</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Student 5</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Student 6</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Student Progress Through the Assessment Process

![Graph showing student progress through assessment process.](image)
At best, half of the students improved comparing the pre and posttest data. All of the students tested struggled with reading. Even when having the questions read many of them still did not understand how to explain their mathematical thinking.

Often when provided the graphic organizer the steps they listed included statements like, “I looked at the problem, then I saw what I needed to do.” When working as a class
together they were more descriptive about the specific steps taken to answer the question. Many of them copied or other students did their work so the class could earn free time. I believe it is the lack of vocabulary that contributed to the overall test scores. Also, many students still struggled with number sense and often didn’t know which operation to use and when.

Also, some of them got the correct answer but failed to write it in the answer space, which automatically deducts one point. Anxiety, classroom disruptions, and inconsistent attendance also played a large role. Many of the students had to make up tests and therefore didn’t put much effort into their work.

Finally, all of my students felt these questions were “stupid” or “boring.” I believe they were not able to relate any of the test content to their prior knowledge and therefore didn’t see the relevance in trying. The questions were inapplicable to their daily lives. One student didn’t understand making popcorn because she had never seen it in seed form. There was some pre-teaching that needed to occur so students could relate to the questions being asked of them.
Chapter 5

Summary and Conclusions

It is apparent that many students lack the vocabulary needed to express their mathematical thinking. Although half of the students improved their posttest scores, it is evident that many of them could not explain their thinking. Even when asked to verbally describe their thinking process during class discussion, students were hard pressed to formulate a logical answer. In the future, focusing on math vocabulary will provide students the necessary tools to explain their conclusions. In addition, focusing on identifying the correct computation, or even finding words in the problem that help identify which operation to use will be curtail in not only getting the right answer on a test, but navigating math outside of the classroom.

Finally, I would love to see the this study conducted with a larger sample, students of different grades, and other populations including those with various socio-economic backgrounds and ethnicity to better represent Milwaukee Public Schools. I would also be interested in expanding the study to students that do not have special needs. I would be curious to see if this intervention would improve their overall scores.

My recommendations for study would be to focus on building literacy skills including vocabulary into mathematics. If students struggle with language, interpreting word problems and understanding math as a language is just that much more foreign.
References

