Going Beyond the Mathematics Textbook

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Introduction

The foundation and guide to most mathematics curriculum is the textbook. Using the textbook as a mathematical clutch in the classroom proves to determine what is taught and what is overlooked in a classroom and also the manner in which the students are directed to learn. "However, when teachers let the text determine the next lesson, they assume that children learned from each page what was intended" (Van de Walle, 2004, p. 48). Using a textbook as the foreground for mathematic education in a classroom has created a growing concern of application of mathematical knowledge outside the classroom. Mathematic educators worry that "many students are able to learn mathematics for 11 years or more but are then completely unable to use this mathematics in situations outside the classroom context" (Boaler, 1998, p.1). So how do we teach the students the processes and procedures to apply in real-world contexts and can this be taught by just using a textbook?

This research and questioning carried over into my own second grade classroom and whether or not my students were simply learning the "hows" of math or the "hows *and* the whys". The heavy sighs throughout my classroom every time I asked my students to take out their Math books forced me to ask myself: "what causes this adverse reaction to math?" and "what can I do to change it?" I focused my Action Research Project around this topic, exploring what would happen if we did math and I didn't ask them to take out their textbooks.

Question

What happens when a textbook isn't the only form of curriculum in a second grade classroom?

Literature Review

Boaler's article "Open and Closed Mathematics: Student Experiences and Understanding" is a case study developed over three years that focuses on two different schools with different approaches to teaching mathematics. She conducts this research project because she states: "There is a growing concern among mathematics educators that many students are able to learn mathematics for 11 years or more but are then completely unable to use mathematics in situations outside the classroom context" (1998, 1). The study looks at two different teaching styles: process-based approach and content-based approach. Process-based approach allows for "open-ended, practical, and investigative work" (Boaler, 1998, p. 2). In contrast, content-based approach focuses on the "traditional" textbook style of teaching, where the students are modeling exactly what the textbook and the teacher show them. Boaler uses these two teaching styles to try and find if process-based approach is more beneficial for meaningful learning.

Over the course of the three-year period, Boaler analyzes student work, test results and student surveys. Her conclusions from her research proved to be very similar to my own research conclusions. She argued that the students who learned using the process-based approach did not "know more mathematics" than the other students,

> rather, the students were able to use mathematics because of three important characteristics: a willingness and ability to perceive and interpret different situations and develop meaning for them and in relation to them; a sufficient understanding of the procedures to allow appropriate procedures to be selected; and a mathematical confidence that enabled students to adapt and change procedures to fit new situations. (1998, 11)

Overall, Boaler's research was an excellent source of supportive findings for my own research.

Van de Walle's article, "Reform Mathematics vs. The Basics: Understanding the Conflict and Dealing with It", provides an enlightening discussion on the Math Wars and where each "side" stands. He explains the Basics as "the mathematics that parents and legislators recognize as the mathematics they attempted to learn when they were in school" (2003, p. 1) – number crunching and computing answers. Van de Walle continues by describing the Reform as having "mathematical power; the ability to reason and solve unique problems" (2003, p. 1) – making the math about the children and their thought process. He uses each of these sides of the war to explain how it affects teaching styles in the classroom. The "Basics" mathematics teacher uses lessons that he calls "parrot math", where the students are mimicking what the teacher is modeling while the teacher is hoping that this mimicking builds learning. This teaching fashion is similar to the textbook style teaching, where the students are either using the teacher's model or textbook model to "plug and chug" the rest of the problems. On the opposing side, the "Reformers" mathematics teacher uses the students' prior knowledge to build new ides. When students are using their prior knowledge, they are "mentally engaged in the act of learning. They must call up those ideas that are relevant and use them to give meaning to the new or emerging or changing ideas that they are developing" (2003, p. 3). Therefore, this type of learning style is creating meaningful learning experiences for the students.

Van de Walle's research on the Math Wars was successful in providing examples and reasoning behind how each side of the war is seen in the classroom, but this article also focused on the importance of teaching mathematics through problem solving. Overall, Van de Walle's article can be used in support of creating mathematic lessons that challenge student's thinking by forcing them to use their prior knowledge to work through problem-solving tasks.

In Chapter 4, *Teaching Through Problem Solving*, of Van de Walle's textbook Elementary and Middle School Mathematics: Teaching Developmentally, he provides detailed descriptions of ways to use resources we have as teachers to create lessons that require students to use problem-solving skills. More specifically, Van de Walle spends a section on how to use the textbook to design and find successful tasks. The use of the "traditional" textbook in a mathematics classroom tends to steer teachers away from selecting effective, problem-solving tasks. Van de Walle states: "Most teachers find their textbook to be the main guide to there day-to-day curriculum. However, when teachers let the text determine the next lesson, they assume that children learned from each page what was intended" (2004, p. 48). Our school textbooks are broken down into "chapters", where students are focusing on day-to-day objectives for an overall goal, like two-digit addition. Van de Walle suggests that the textbook should be used as a resource and guide, not the means for what is taught every day.

Furthermore, Van de Walle discusses how the use of only textbooks does not create the possibility for a "problem-oriented approach". Textbooks are broken down in a manner that is teacher directed, providing examples in the text and from the teacher and then the student is asked to repeat the exact same task. Van de Walle suggests using the textbooks to "adopt a unit perspective"; find the big idea of the unit and adapt lessons to best explain that task at hand. He states: "With the big ideas of the unit in mind, you can how do two things: (1) adapt the best or most important lessons in the chapter to a problem-solving format and (2) create or find tasks in the text's teacher notes and other resources that address the big ideas" (2004, p. 48). Using our textbooks as a guide can help teachers create lessons that not only build on prior knowledge but allow students to develop problem-solving skills, skills they can use and apply when they are outside of the mathematics classroom and in real-world situations.

Data Collection

My school, Our Lady Star of the Sea, is located in Grosse Pointe Woods, Michigan and is a Catholic School apart of the Archdiocese of Detroit. Although the school itself is apart of a very affluent community, due to lack of funding within the private schools – our resources are very limited. The Star of the Sea community is predominantly middle to upper class Caucasian families, with very limited diversity. Due to the nature of our families, there is a very strong parental involvement in both the school and the church, which creates a supportive community for both the students and the teachers. Specifically, my class consists of seventeen students, nine boys and eight girls. This is my second year teaching second grade at this school.

My research within my classroom took four math periods (45 minutes each) to collect. Due to a lack of resources within our school, my options of incorporating other resources in the classroom besides the textbook were very limited. To compare textbook use to outside resources, I decided to teach the same domain in two different ways. The domain I chose was 2-digit addition with regrouping. I chose this domain because I felt my students last year had difficulty with this concept and that there wasn't enough explanation of the process in the textbook. The first day the students were given a pre-assessment on what they knew about addition with and without regrouping. Day two, I followed the exact guidelines of the textbook and the students completed their textbook page. This page gave the students a sample problem at the top and then asked them to complete the exact same problems with different addends. At the end of the lesson, I distributed a survey for the students to fill out about how they felt the lesson went. They were asked what they liked and what they didn't like about the lesson, if it was easy or hard and finally what they learned in math that day.

The next day, I used outside resources to create a Math Workshop. The Math Workshop began with a 10-minute mini-lesson about 2-digit addition with regrouping, similar to the examples from the day before. After the mini-lesson, the workshop broke off into four different rotations, or centers, for the students to complete in groups. The first rotation was teacher directed. I had a large place value and ten-frame mat for my students and myself to model the 2-digit addition problems using tens and ones blocks and illustrating it on our recording sheet. At this rotation, group members came up with their own 2-digit addition problem with regrouping and we completed them together. At the second rotation, students were working on a worksheet together that was 2-digit addition without regrouping. This center was to help the students become familiar with the process of adding the ones and then the tens. At the third rotation, the students were using tens and ones blocks to come up with their own 1-digit and 2-digit addition problems. At the fourth rotation, the students rolled dice to create 2-digit addition problems. After the Math Workshop, I distributed a survey to the students asking them four questions: what they did/did not like about the lesson, whether it was easy or hard, what they learned about today and which lesson they liked better. The final day I administered the same assessment as day one. Overall, the data I collected over the course of this action research project included: student work, student surveys and the pre and post assessment.

Data Analysis

Over the course of this research project, I tried to collect and analyze as much data as I could to help answer the question of what happens when we use more than just a textbook in our classroom. Van de Walle states: “Too many teachers interpret the textbook curriculum as ‘getting students through the student pages’” (2004, p. 88). This is exactly what I was trying to show my students – that math could be more than just textbook pages and repetitive problems.

When I gave my students the open-ended questions for their pre-assessment, they all stared blankly at me – as if I had given them a test with long division. I wanted the students to use problem-solving skills to develop their own one-digit and two-digit addition problems. "Problem solving places the focus of the students' attention on *ideas* and *sense making* rather than on following the directions of the teacher" (Van de Walle, 2003, p.1). This pre-assessment not only showed me what the students already knew and what they do not know about addition and regrouping but it also showed me that with all the teacher-directed instruction in math, my students struggled when it came time to come up with their own problems without a model. Although, the first two pages of the pre-assessment covered "review" material of adding one-digit and two-digit numbers without regrouping, the "unstructured" problems of having to come up with their own addition problem really confused some students. As Boaler stated in her research comparing open and closed mathematics, "questions that did not require an obvious and simplistic use of a rule or formula caused students to become confused" (1998, p. 4). This confusion led to thirteen of my seventeen students getting at least one or more wrong on the first two pages, material that we had already covered in the beginning of the year. During the pre-assessment, many students asked, "Where are the numbers?" or "I don't get what to do because there is no example". This showed that the traditional textbook does not allow for a problem-solving thought process or the use of open-ended problems. "Most traditional textbooks remain very close to a 'teach by telling' model. It is simply not possible for the text to pose problems or tasks in the student books and not provide the solutions or explanations" (Van de Walle, 2004, p. 88). Thus, if the students had so much difficulty-using problem solving skills on the pre-assessment, what were student reactions when we moved past the textbook repetition of problems?

In comparing the survey results of the textbook lesson and the math workshop lessons – the students brought light to several different factors about how they feel about math textbook pages and math workshop, or center work. Boaler (1998) states:

> Supporters of process-based work argue that if students are given open-ended, practical, and investigative work that requires them to make their own decisions, plan their own routes through tasks, choose methods, and apply their mathematical knowledge, the students will benefit in a number of ways. The reported benefits generally relate to increased enjoyment and understanding. (p. 2)

Not only was I looking at this research question as performance based but I also wanted to incorporate the students' opinions and feelings about their every day math lessons and what happens when outside resources are incorporated. One response that several students gave for the textbook lesson was that it was very "easy". Several students also shared that they felt it was "boring" or "not very fun". One response that struck me was a student shared: "I didn't like this lesson because I was doing the same problem over and over". This response coincided with Boaler's results: "In the lessons that I observed, students often demonstrated a marked degree of disinterest and a lack of involvement with their work" (1998, p.3). She further went on to state that in her research she asked her students what they dislike about math at school: "49 students (31%) criticized the lack of variety in the school's approach; 77 students (48%) also reported a lack of practical or activity-based experience. […One student continued] 'I wish we had different questions, not three pages of sums on the same thing" (1998, p. 4). Boaler's work with two different classrooms (one process-based and the other content-based) resulted in the same finding from my student surveys.

In response to the math workshop lesson, I found similar results to Boaler, but also gained additional insights on my own students. One thing both Boaler and I found in studying the process-based math is that the students enjoyed completing the math and "had fun". Several of my students said they liked the math workshop lesson better because doing the math was "fun"; they were able to use dice and work in centers. Although my findings support a stronger student reaction and better understanding of the domain that was taught, this research project all showed me that not all "other resources" will always work with the different learners in a math classroom. I had several students share in their survey that they would have liked the math workshop better if they didn't have to complete the tasks in groups – this response came from my students who are academically strong in math. Students who were at grade level or below grade level loved using the manipulatives and being able to work with one another.

Conclusions

In conclusion, my research disclosed that the students showed great improvement from the pre-assessment to the post-assessment in being able to apply what they know to their own problems[1]. This research also recognized that not all "outside" resources could be successful in every classroom; there can be other influential factors – such as student achievement levels or student interactions. It is important to understand how your students work in groups or partner activities and build outside activities around these results. Bringing in an outside resource into the math classroom once a week has proved to be very beneficial. We have done partner work, more group work and incorporated manipulatives into our lessons. Math workshops are just one piece of endless possibilities to incorporate into a math classroom.

[1] See chart attached at the end of the project.

This Action Research Project has shown the impact of incorporating lessons outside of just the classroom textbooks. I have begun to develop different ways to teach the textbook material without using the repetitive textbook pages. I have discussed with my principal the opportunity to share my research and results with my colleagues on the importance of spending the time to mix textbook assignments with outside resources. Boaler (1998) concludes:

> The learning that the students developed in response to [the process-based] approach appeared to be more usable than that developed from nonapprenticeship teaching. It seemed that the act of using mathematical procedures within authentic activities allowed the students to view the procedures as tools that they could use and adapt. (p. 11)

Overall, my research showed that it could be very beneficial to incorporate outside resources into your mathematics classroom – even if the students believe it's just to make math "fun".

References

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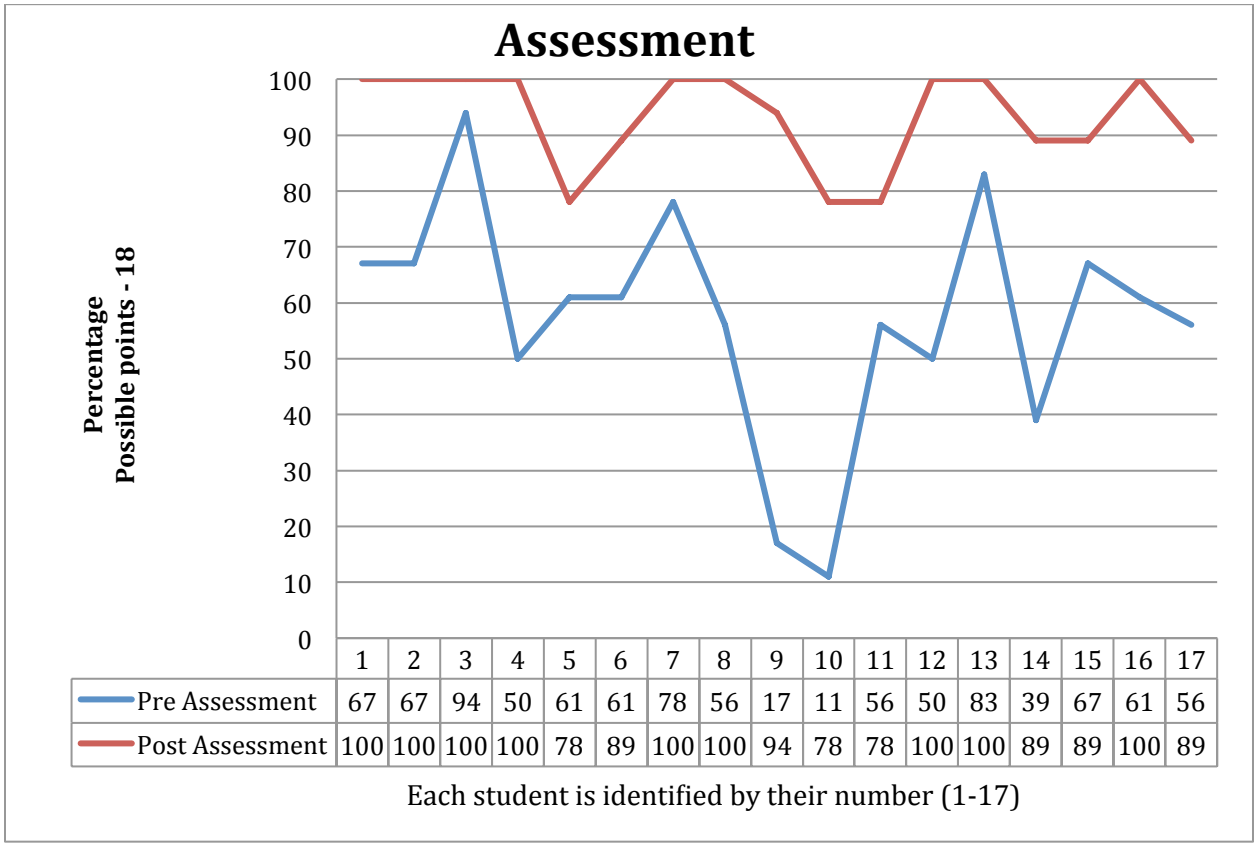
Pre and Post Assessment Data



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Pre Assessment	67	67	94	50	61	61	78	56	17	11	56	50	83	39	67	61	56
Post Assessment	100	100	100	100	78	89	100	100	94	78	78	100	100	89	89	100	89