What does 2.0 have do with the Literacy Classroom?
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Abstract: Teaching English/Language Arts in today’s classrooms requires teachers to implement digital media and new literacies alongside more traditional literacies. Twitter. Blogs. Webpage creation. Pinterest. N.design. Prezi. Among others. Do these tools have a place in the literature classroom? Today’s adolescents read, learn, and communicate with print, digital technologies, and new media. This paper focuses on working with teachers and coaches to combine effective literacy responses with digital literacies for adolescents. Student choice in both media avenues and text selections is vital to preparing students for tomorrow on today’s budgets Creative integration of the new with the more traditional will help many educators bridge the technology gap and leap into the 21st century.

Twitter, blogs, webpage creation, Pinterest, N.design, Prezi, Shelfari, Myebook, and the like are flooding the world wide web with new creations and thinking. Today’s adolescents read, learn, and communicate with traditional print, digital technologies, and new media. Changes are occurring rapidly in regards to technology, and its use for communication and production of new understandings of content (Dearstyn, 2007). Do these tools have a place in the literature classroom? There is much discussion on web 2.0 tools and whether they should be included in the literacy classroom (Gorman, 2007), many teachers and researchers are exploring the use of these digital tools with students (Achterman 2006; Alvermann, 2006; Richardson 2007; Warlick, 2006). Hopefully it is our goal in American schools to engage students in developing inventive thinkers and effective communicators with high levels of personal, social, and civic responsibility. Therefore, students must learn to “step into the global conversation and develop competencies” in using digital media and new literacies alongside more traditional literacies (Banister, 2008, p. 110). So how can teachers implement and engage students in such practices that combine effective literacies skills?

Student choice in both media avenues and text selections is vital to preparing students for tomorrow on today’s budgets. This paper shares how teachers, coaches, and students engaged in varied digital designs and processes. Creative integration of the new with the more traditional will help many educators bridge the technology gap and leap into the 21st century. First, examples of student-created projects will be shared including discussion of successes and challenges. Following this will be ways to implement 2.0 literacies tools in classrooms.

Blogging
Teachers and researchers have already documented the effectiveness of using blogs to support student conversations and storytelling (Huffaker, 2005). Creatively using blogs to support reading instruction and response to literature. One way that blogs can be used to support reading response is through making connections with text and other websites. An example of such project could be with George Orwell’s book Animal Farm. This is a novel about the dangers of a totalitarian government in which farm animals overthrow their tyrannical human master. The animals set up a democratic government of their own but eventually the pigs take over and form a new tyrannical rule.

After reading Animal Farm, students were asked to create a blog post on Monday, Wednesday and Friday in which they were to find something from the web that seems relevant in discussing the novel. This could be any news article, video, song, comic, etc., as long as it relates to a major theme of the novel. Students were also required to explain the rationale of their choices (See Figure 1). This type of activity will gauge whether or not students are understanding the themes of the novel and will reveal to the students in what ways that literature we read is relevant to our everyday lives. Animal Farm is perfect for this activity, especially given the recent events in the Middle East. In providing a rationale, students will reveal their understanding of the novel. Additionally, they will discuss certain
characters along with the themes of the novel, moreover this affords teachers to see students apply the information and ascertain whether or not students understand larger concepts associated with the novel, not if they memorized characters or plot.

Figure 1: Student Post of Response to Literature on Blog

These blog posts were developed over time and could serve as a model for other literacies projects in creative writing, informative reading, and writing for real audiences. Audiences larger than the teacher where students can comment and help each other make sense of learnings and gain greater understandings. A similar, but more visual way to use Web 2.0 tools in the ELA classroom is through the use of Pinterest and online connections.

Pinterest

Pinterest is an online bulletin board-style sharing website that encourages users to create and manage theme-based image collections such as events, interests, hobbies, and more. Pinterest began in 2010 as an invitation only social networking site; however, in late summer 2012, invitations to join were no longer required, which makes it more open for students to use in the classroom.

In one of the first assignments using Pinterest was with character analysis using a self-selected novel. Students chose a book to read independently and create five boards about a character from the novel. Each “Pinboard” was to highlight an important aspect about your character’s identity. Students were asked to consider the character’s interests, hobbies, relationships, and/or discoveries (See Figure 2). Each board required a comment about how the character changes through the pins placed on the boards. In the example in Figure 2, the student chose to read *The Uglies* by Scott Westerfield. In this novel, every teen undergoes extensive surgery at the age of 16 to
become supermodel gorgeous. After surgery completion the new pretties have one job: enjoy living in a high tech society, yet some teens begin to push back on the bureaucracy of the surgery.

So, what’s the difference between making a paper collage and a digital one? Yes, students could cut and paste from magazines or draw; however, the digital portion encourages easily participation from others in and outside the classroom. The collaborative nature is what makes Web 2.0 magical in the classroom (Knobel & Lankshear, 2007). Not only do students find the digital aspect of creating more engaging, but also they are able to construct knowledge and add to each others understandings remotely and collaboratively in and out of the classroom. In addition to blogs and Pinterest, students can expand the role of the classroom through the social media tool, Twitter.

Twitter
Twitter is an online social network that affords users short bursts of information (140 characters); essentially “microblogging.” Twitter can also be beneficial in the classroom in a number of ways. Teachers can give students differentiate reading responses to assigned readings by encouraging students to tweet their responses (See Figure 3). In lieu of a traditional written one-page reflection, in the fall of 2011, two undergraduate students chose to read the assigned readings and engage with me throughout the week on Twitter. We read the assignment, tweeted our thoughts and ideas, and responded by asking questions or adding to their ideas. Pushing the conversation on our readings out of the classroom into a more accessible setting was beneficial to student understanding and comprehension of the new material, as seen in the brief exchange in Figure 3.
Another way to engage with Twitter in the classroom is through a characterization unit of study. Characterization units, found in every ELA classroom, are where students study the author’s techniques of developing characters through direct and indirect manners. For example, students analyze what characters say and do, what other characters say about them or do around them, and/or, what the narrator and author say about the characters. Using this information, students created Twitter accounts for the characters of the novel, The Lion, The Witch, and The Wardrobe by C.S. Lewis, a story of children’s explorations into a magical world of Narnia. In Figure 4, we see twitter handles for three of the four main characters, Susan, Lucy, and Peter. At different points in the novel, students assume the roles of the characters and tweet responses to create a conversation. In this posting, students chose to use present day language to represent each character’s thoughts.

Not only can Twitter be used for reading response and novel studies, but also Twitter can host a number of activities in the classroom. Students and teachers can openly communicate, ask questions, share announcements, talk with authors, consult experts in the field, find great resources and the like. There is something to be said for asking a question about a text, tweeting the author, and more often than not the author responds quickly opening the conversation to more learning.

Final Thoughts

From these experiences, web 2.0 tools (specially blogs, Pinterest, and Twitter) were demonstrated to be effective and engaging resources in supporting reading achievement and understandings for students. These resources have potential to expand reading and and writing in the K-12 classroom. Areas such as comprehension of texts, connections to the real word, development of vocabulary, and providing evidence or support for choices could all be positively influenced in the ELA classroom. Particular strengths of these web 2.0 tools are their features that are sequential, archival, interactive, and collaborative. Material can be easily updated and students can collaborate together to deepen understanding of material. Furthermore, Web 2.0 tools encourage the content to be extended beyond the teacher and student to connect to other students and information of websites can be linked in to expand
learning.

This reflective examination of using web 2.0 tools in the ELA classroom, while narrow, does indicate the possibilities of expanding traditional paper responses to student readings and understandings. Supporting students literacies development through their engagement and willingness to participate in activities outside of the classroom using web 2.0 tools provides a beginning framework for others to adapt and integrate technologies into their ELA content and coursework.

Is there room for Web 2.0 in the current ELA classroom? Yes, teachers must continue to reach students through each student’s individual interests. Guthrie and Wigfield (1997) defined motivation as unique to individuals based upon “beliefs, values, needs and goals” (p. 5). Hence, the closer teachers can align literacy activities with these beliefs and values, “the greater the likelihood that students will expend effort and sustain interest in them” (Pitcher et al., 2007, p. 378). Using Web 2.0 tools enables the teacher to bring popular themes, technology, and activities into the classroom. In engaging reluctant or “at-risk” readers with technology they enjoy, I have found that they are more willing to trust me, the teacher, when it is necessary for us to read a required, “higher” literacy text.

However we, as teachers, feel about such practices, these digital, Web 2.0 activities are as important to students as students understanding concepts and thinking critically is to teachers. So why not blend the two? We can utilize the students’ interests in technology as motivation to read novels that will improve their literacy skills, build authenticity and autonomy, capitalize on intrinsic motivation, and allow them to experience more successes in and out of the classroom.

References

Literature Cited

- 4529 -
Learning to use virtual technology to represent mathematical ideas

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Abstract: Teaching mathematics in today’s educational climate requires teachers to focus on developing conceptual understanding and mathematical thinking through inquiry, collaboration, and communication while using technology-based tools and materials. One avenue toward developing and strengthening teachers’ pedagogical content knowledge and teaching practices using representations is teaching mathematics content through the use of virtual and interactive manipulatives. This study reports on how four elementary teachers learned to integrate virtual tools into their teaching practices and how these technologies were used to represent math ideas. We found that teachers began working with virtual tools that had physical counterparts but moved to expand on the physical uses, learned to link general and technical mathematics language with virtual tools and representations, and used the SMART Board as a multi-purpose organizational display tool.

Purpose

In today’s schools, teaching mathematics requires teachers to focus on developing conceptual understanding and mathematical thinking through visual models, strategy development, inquiry, collaboration, and communication while using technology-based tools and materials (NCTM, 2000). The goal of these efforts is to prepare students for a workplace and world that is technologically advanced and information rich. Students have many choices and options available to them in learning that have not been available before. For today’s student, learning to make good choices about which tools best represent the needs of a problem or task has become a ability to support students’ nuanced representing skills through the use of virtual and interactive tools. Virtual tools offer a much wider range of representational possibilities that are not possible with physical tools or pictorial representations alone. Additionally, interactive virtual systems, such as interactive whiteboards, allow for more interactivity between the user and the system, offer greater opportunities for social interaction and language development, and provide multiple pathways for representing mathematical ideas, both concrete and abstract (Jonassen, 2003; Moyer-Packenham, Salkind, & Bolyard, 2008; Pape & Tchoshanov, 2001; Sfard, 2000). Integrating virtual tools, interactive whiteboard technology, and other software into teaching practices can support and/or change how these tools are used to represent math ideas in mathematics problem solving, computation strategies, and mathematical discourse. This study investigated how teachers learned to integrate and use virtual tools, via interactive whiteboard technology, to represent mathematical ideas.

Methods

Our research design was a year-long qualitative observational study that used in-depth video data coding and analysis, pre-post observational rating inventories, teacher biographical questionnaires, and teacher interviews. The sample for this study was four self-selected, in-service female elementary teachers, in grades 1 – 5, ranging in teaching experience from 2 to 10 years (see Table 1.). One of the teachers in the study also served as the co-PI. The teachers taught in a large suburban district of approximately 12,000 students in the northeastern United States, with a student population that was predominately middle to high socio-economic status.

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Grade</th>
<th>Years teaching at start of study</th>
<th>Education</th>
<th>Previous interactive whiteboard use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanessa Morgan</td>
<td>5</td>
<td>1</td>
<td>BA English/Pre-Med with Elementary Certification</td>
<td>No</td>
</tr>
<tr>
<td>Camille Long</td>
<td>3</td>
<td>2</td>
<td>BA Elementary Education</td>
<td>Yes</td>
</tr>
<tr>
<td>Tina Kohl</td>
<td>2</td>
<td>9</td>
<td>BA Elementary Education/Sociology</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- 4530 -
Nicole Robbins  1  1.5  BA English/Childhood Studies  No

Table 1. Teacher Biographical information (all names are pseudonyms)

The teachers in this study engaged in monthly professional development workshops from September to May in the 2007 school year. These workshops had three focused objectives: to strengthen the teachers’ content knowledge of the mathematics they were currently teaching, to increase their skills in mathematical discussion and questioning, and to support their learning of the SMART Board technology and software.

For this study, the teachers were trained to use a Smarttech SMART Board brand interactive whiteboard. The teachers were asked to teach a specified unit on number sense and operations that would be recorded for analysis four times during their chosen unit of study. After each observed lesson, the teachers wrote a journal reflection using pre-determined prompts that focused on their thoughts about the lesson as well as the goals of the study.

To capture events from the recorded classroom observations, we used an adaptation of the MKT observational video instrument, designed by members of the Learning Mathematics Teaching Project (2006). This instrument was created to capture the quality of mathematics in instruction. Each observed lesson was segmented into five-minute clips. The codes were marked as either present or not present and then coded as appropriately or not appropriately implemented, as defined by the MKT instrument description. These codes were tabulated and analyzed within each lesson, across the individual teacher’s group of lessons, and then across all four teachers in the study.

Practice-focused Professional Development

Supporting the development of teaching practices in order to represent multiple levels of student thinking is not an easy endeavor. As such, providing teachers with the time and opportunity to study and reflect on their teaching practice is crucial in their professional development. The teachers in this study were afforded monthly opportunities throughout the school year to work on mathematical problem solving, learn about SMART Board tools, software, and possible uses in the classroom, discuss and analyze student thinking, and work with the math topics of numbers and operations.

The teachers had varying levels of experience in teaching with a SMART Board. It became important to allow the teachers ample time to learn about the features of the board, what worked well and what didn’t, and how to make choices about which tools would best represent the math topic in a lesson. It was no surprise that the teachers who had more experience and familiarity with the SMART Board were better able to represent mathematical ideas using the board. What was a surprise was how much time was needed for all the teachers to become familiar with the available tools that could be used to think through math concepts and problems. Becoming familiar with the different tools in the SMART Board software was a time-consuming process; once familiar, the teachers then needed to learn to make choices about which tools could represent math ideas effectively. This process was a continuous one; we wanted the teachers to become confident with working with the different tools, thus we provided them with ample time to learn about them, even as this pushed some goals of the study to the side.

The professional development sessions did not only focus on learning about the SMART Board features and tools; the sessions also focused on math content in numbers and operations and learning to represent mathematical thinking. The teachers were asked in each session to solve a high school level problem and one teacher was chosen each month to facilitate the solution discussion. The facilitating teacher was given time to solve the problem on her own, come up with multiple ways to represent the solutions, and then to facilitate the discussion with the group during the professional development meeting. This exercise was used to provide teachers with the opportunity to work through the practice of drawing on student ideas, develop representations for those ideas, and find connections between and among them.

What became evident in our study was the importance of the professional development sessions and the role they played in supporting the learning of a new technology. Attending a one-day workshop or a district or school in-service to learn new technologies or software only scratches the surface. The opportunity to try the new technology, critique it with others while learning to use it, ask questions and explore new uses will create buy-in for the tool and help teachers persevere through difficulties and problems. Tina talked about the difficulties she had with the SMART Board, "The only time it became a hindrance was when it was not working properly. Trying to conduct a classroom discussion with an uncooperative SMART Board and
second graders usually leads to distractions and lots of giggling. It becomes a classroom management disaster. When it was not oriented properly, the students could not write legibly on it and it became difficult for the other students to understand the students’ strategy. As a result, the messy writing became a distraction. But because we knew that the other teachers may have the same issues, we addressed this problem during our professional development meeting and came up with solutions to get through those technical difficulties”.

**Using and Expanding the Role of Tools and Representations**

We were also interested in understanding how the teachers were able to use the SMART Board as a tool for representing mathematical ideas in place of or in addition to using other tools such as the chalkboard, posters, overhead, etc. (see Table 2). Using the SMART Board to record and display information occurred in 74 clips out of 89 clips (83%) in which the SMART Board was used. Teachers almost exclusively used the SMART Board during the whole group portion of their lessons, which showed their willingness to incorporate the SMART Board into their work. At first glance, using the SMART board as if it were a chalkboard seems like a limited use of such a powerful piece of technology. The teachers used the SMART Board to record their writing, display needed information, and present student solutions and ideas in place of the whiteboard or chalkboard. However, as we looked more closely, we found that the teachers began to use the SMART board to replace other means of public display in the classroom. Instead of using a whiteboard, chart paper, posters, or other displays, the teachers put everything they wanted to show on the SMART board. Doing this made everything for a lesson accessible and in one place, easing some of the preparation and implementation burden of the lesson and taking advantage of the SMART Board’s productivity.

<table>
<thead>
<tr>
<th>SMART Board uses</th>
<th>Clips with SMART Board (89 clips using SMART board)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using SMART Board as a chalkboard to record/display information</td>
<td>83%</td>
</tr>
<tr>
<td>Using tools to represent math idea or solution</td>
<td>47%</td>
</tr>
<tr>
<td>Using tools with mathematical language to explain or describe</td>
<td>43%</td>
</tr>
<tr>
<td>Linking a concrete/virtual representation to another representation or to symbolic math</td>
<td>30%</td>
</tr>
</tbody>
</table>

*percentages add up to more than 100% because teachers could be coded for more than one use in a clip.

**Table 2. Teacher uses of SMART Board during lesson**

Learning to use a SMART Board can provide teachers with a wider range of tools to support their teaching and student learning. As we have discussed, the teachers in this study tended to use tools they had prior experience with in a physical context. We wanted to look at how teachers expanded the physical uses of tools when they incorporated a virtual counterpart of that tool. By expanding the qualities of a tool, we mean using the virtual tool in ways that cannot be duplicated easily or at all with a physical one. This expansion is more than just a surface feature or time saver of the virtual tool. Expanding how a tool is used or is portrayed opened up different opportunities for making mathematical connections, creating large-scale representations, and representing the action of mathematical thinking.

**Making Mathematical Connections**

Teachers in the study found ways to use virtual tools to make connections between a pictorial representation of a math idea to its symbolic representation. As an example, the second grade teacher, Tina, was able to make these connections when she worked with virtual base ten blocks. She would display the correct representation of a number, say 26, and write the value of the blocks either on the blocks themselves or next to them. This allowed her to provide her students with an immediate visual, oral, and symbolic representation of the amount 26, something that would be more difficult to do without the SMART Board. Additionally, she could move the entire visual, blocks and written symbols, to another place on the board to show addition to another number. With physical base 10 blocks, on the overhead, she would be limited in where she can move the blocks and how she could represent the amounts of the blocks, individually and as a
whole amount. By keeping the written place values as well as the whole amount on display, she was reinforcing the ideas of place value while she worked through addition of 2 digit numbers.

Creating Large-scale Representation

One surface feature of the SMART Board and its tools is the presentation size of the board. SMART Boards are usually set up with very large screens that can be seen from almost any part of the room and some can be raised or lowered so it is at eye level with students. Teachers in the study commented on how much easier it was to demonstrate activities, homework, problem solving, directions – anything that the entire class needed see at the same time. Though a computer and projector offers the same features, what it doesn’t offer is the ability to change the size of the objects being presented to larger sizes. On a SMART Board, any object can be resized to explode the details (if the original object has a high enough resolution) or make larger for better viewing. A third grade teacher in the study, Camille, felt this feature of size offered her the ability to demonstrate a balance scale for the entire class at once without the distraction of student having their own balance scale in front of them during her demonstration. Also, students were able to come up to the SMART Board and model with the teacher how to use the scale while she reviewed the features of the scale and methods for weighing items on it.

Representing Mathematical Action

A SMART Board is not the only way teachers can use tools and representations to show the action of mathematical thinking, but it makes demonstrating thinking easier and more accessible. Teachers were able to use virtual tools, such as base ten blocks or hundred boards, to follow each step of a student’s presented strategy. On the SMART Board, more tools were readily available and could be brought out on the screen from the Gallery, cloned, resized, or recolored to provide teachers with multiple options for showing student thinking. For example, as the first grade teacher, Nicole, had her students share their strategies for finding sums using coins, she kept a set of coins that could be infinitely cloned (coins can be continuously created by touching the cloned coin) on the screen; this allowed her to create the correct value and amount of coins needed to represent the solution strategy being presented by her students. The movement of the coins, as they represented the values being added to make the desired sum, gave the students a visual process for the strategy steps being discussed. Additionally, she also wrote the amounts being added as she moved the coins toward the solution. Here, again, the teacher made a connection between the concrete representation of adding coins to the symbolic representation of number addition. Though, in some ways, this kind of representation of solution strategies could occur on an overhead, on the SMART Board because the tools are virtual, there would be no need to have a large amount of coins available for use, as the teacher can create any amount that would be necessary.

Using mathematical language and linking representations

Representations afford teachers multiple opportunities to expand the meaning of mathematical ideas; this allows many children to grasp mathematical concepts, not only those students with strong memories (Jonassen, 2003). Linking multiple representations - oral, visual, concrete, virtual, written - with technical and general math language creates bridges for students when learning about abstract mathematics ideas. We coded the teachers’ use of language using a technical and general language code (see Table 3). Technical language allows students to enter into the realm of a mathematician; learning to understand and use the language of mathematics to communicate ideas – subtraction, addend, fact family, number sentence. We looked for teachers’ use of mathematical terms in connection with representations on the SMART Board. General language, on the other hand, bridges the gap between students’ current and prior mathematical knowledge, the representations of new mathematical ideas, and the technical language used to describe them. Language usage is strongly connected to linking multiple models and mathematical ideas. Being able to point out how different representations are connected, similar, or different not only supports deeper learning for students, it also reflects a need for strong mathematical understanding in teachers. In classrooms where students are encouraged to consider multiple solutions to problems and tasks, the teacher must draw
on a deep well of mathematical knowledge in order to make sense of student thinking and know what tools and representations can be used to explore and link those ideas together to make a coherent whole. Providing teachers with time and support to develop this type of knowledge is important for learning how to incorporate new tools and technology.

<table>
<thead>
<tr>
<th></th>
<th>Technical language usage</th>
<th>General language usage</th>
<th>Linking language with tools and representations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanessa</td>
<td>71%</td>
<td>38%</td>
<td>18%</td>
</tr>
<tr>
<td>Camille</td>
<td>66%</td>
<td>55%</td>
<td>29%</td>
</tr>
<tr>
<td>Tina</td>
<td>56%</td>
<td>53%</td>
<td>28%</td>
</tr>
<tr>
<td>Nicole</td>
<td>65%</td>
<td>17%</td>
<td>39%</td>
</tr>
</tbody>
</table>

Table 3. Teacher percentages of language use with SMART Boards

Some teachers in the study demonstrated a strong ability to link math language with representations of ideas and SMART Board tools. In over 50% of her clips, Camille used general language to explain a mathematical idea. She also consistently used technical language to describe mathematical topics in 66% of her clips. With the SMART Board, Camille linked the displayed representations with general and technical language in 12 of her clips. Camille also used a wide variety of SMART board tools and allowed students to explain their thinking using those tools and their own representations. Another area that supported student learning through representations was Camille’s use of the physical tools that could be matched to the virtual tools on the SMART board. In about 50% of her clips, her students were working at their desks with a manipulative she introduced or demonstrated on the SMART board. Students had the opportunity to see her model the activity or problem before they attempted to do so on their own. In her interview, Camille discussed what she considered a strength of the SMART board. “The simulation (on the SMART Board) helps to apply what was learned and helps provide a deep knowledge of the concepts taught. It also helps visual and kinesthetic learners. My students and I are able to manipulate objects on the SMART Board to help them better see abstract thinking problems.”

Vanessa used a high percentage (71%) of technical language in her classroom. However, this language was generally used to set-up ideas for the lessons or revoice directions for an activity; less often did she use technical or general language to discuss or explain mathematical ideas. This lower use of language to explain ideas was evident in her code for linking models; she did not use a wide variety of tools in her lessons, thus only used language to link multiple representations together in 18% of her clips. Although she allowed her students to describe and explain their work on the SMART Board with tools and representations, she did not use the SMART Board frequently to describe or explain mathematical ideas herself.

The idea of using language to describe and explain mathematical ideas with written symbols and sometimes tools is not new; teachers do this often when modeling a concept during lessons. Here, we noted that the teachers drew on the practice of modeling as a way to connect language to both physical and virtual tools. The teachers began linking language with concepts and tools in a modeling fashion; describing and explaining how to do something and then writing (or have students write) the work on the SMART board. Similarly, as the teachers gained more experience learning to connect tools to their verbal explanations, they will expanded the ways they are able to represent a math idea or topic. Learning to explain student thinking with tools is a needed stepping stone to increase the teaching practice of linking concrete manipulatives to symbolic representations.

Discussion

Virtual tools, with an interactive whiteboard, provides teachers with many tools at their fingertips, the ability to save work, scan in multiple items, including student work, and to create and/or recreate physical objects with just a tap. The ease of having needed tools readily available can become a catalyst for increased tool use and representations in a teacher’s practice. However, being able to find and use virtual tools to expand representational teaching practices requires a commitment of continued learning and extensive planning time. Each of the teachers talked about the amount of preparation that was needed to
write the lesson, understanding the mathematical conceptual framework that was going to be explored, selecting the correct tools and ideas, and then preparing the slides and making sure that they worked correctly. This advanced preparation was necessary in order to develop a cohesive lesson that attempted to fully represent mathematical ideas in a more conceptual way. However, this level of planning is very time-consuming and can be daunting to a newcomer to this technology (Hennessy, Ruthven, & Brindley, 2005). Having support through this process is crucial in learning to use virtual tools to their fullest potential. Also, support for trouble shooting, investigating, and reflecting on teaching practices would encourage teachers to continue learning and working with virtual tools and other new technologies. A school wide commitment to professional support and time to study technological teaching practices is warranted.

The implementation of virtual tools requires a significant shift in mathematics pedagogy toward more inclusive teaching practices that focus on the intersections of deep understanding of mathematical topics, the mathematical process used, the communication of mathematical thinking and doing, and the mathematical products that are created. Teachers need to become students of these technologies and tools; it is not enough to “add-on” these tools to existing practices. Supporting teachers with continuous learning opportunities, particularly in mathematics and technology, is of vital importance for the mathematical future of our students.

Looking ahead, we see that developing students into critical thinkers and problem solvers has become paramount; no longer do we need workers who can “plug and chug”. This study provides a picture of how teachers’ level of knowledge and comfort of math teaching interacts with their knowledge and comfort of innovative technologies in a way that influences the implementation of new tools in the mathematics classroom. In this current state of reform, teacher educators need to provide opportunities for new users of the technology to comfortably introduce virtual tools into their classrooms as a pathway to move student and teacher mathematics learning forward.

References

Middle School Math and Science Teachers using Video to Notice Student Thinking

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Abstract: Effective reform-based teaching in science and math requires that teachers implement strategies that attend to and respond to students’ ideas in the classroom. Classrooms are complex. Thus, being able to notice students’ ideas can be challenging. To support teachers in paying closer attention to student thinking, I designed a video club to help teachers hone their noticing skills. The objective was to improve how teachers attended to and made sense of student ideas (Sherin, Jacobs, & Philipp, 2011). With this goal, I found it helpful to set parameters for clip selection and discussion topics. Additionally, through post-club interviews, I found that while club sessions themselves were valuable, preparing clips and reflecting on club discussions independently proved to be important in helping teachers think about ways to shift their practice toward visions of reform.

Introduction

To improve mathematics and science achievement, reform efforts call for a change in the teaching and learning of mathematics and science (National Commission on Mathematics and Science Teaching for the 21st Century, 2000). Often this change is different than how teachers learned math or science, which makes it difficult to interpret and put into practice. In particular, teachers need to place students in the center of the learning environment, as active constructors of knowledge, rather than passive absorbers of facts. Essential to this pedagogical shift is that teachers need to implement strategies that attend to and respond to students’ ideas in the classroom. With the complexity of classrooms, being able to notice students’ ideas can be challenging. One way to support teachers in developing knowledge and skills to play closer attention to student thinking is to have them reflect on practice – their own and others’.

Recently, video clubs are being explored as potential contexts for teacher learning (van Es & Sherin, 2008). Video clubs provide a format that encourages teachers to hone their noticing skills in a reflective, collaborative, and productive way. To support teacher learning, video clubs are situated in teachers’ own practice (Cohen & Hill, 2000; Putnam & Borko, 2000) and allow teachers to reflect on their own practice, observe other models of practice, and attend to details in instruction that can often be overlooked in the moment of teaching (van Es & Sherin, 2002).

The video clubs discussed in this study aimed to improve how teachers attended to and made sense of student ideas (Sherin, Jacobs, & Philipp, 2011). This meant two things. First, teachers needed to notice when and what student ideas were visible and expressed. Second, teachers needed to explore how teacher moves drew out or hindered students from expressing their ideas. To accomplish these goals, I incorporated monthly video clubs into a semester-long course for middle school science and math teachers who were enrolled in an urban masters program at a local university. I believed that pairing video club with practical experiences would provide teachers with models of teaching in real classroom contexts and a forum to discuss issues that were relevant to where they were in their professional teaching trajectory. I believed benefits of peer interaction and self-reflection (So, 2012) would help teachers develop their ability to notice student thinking as observers of others’ practice as well as within their own, which would then translate into actions in their own practice to improve their attention and response to student thinking.

Study Design

This study focused on the use of video clubs to support teachers in developing an understanding of what it takes to notice student thinking. Part of noticing is acknowledging that students are thinking, and part of noticing involves responding to student thinking (Sherin, Jacobs, & Philipp, 2011). Thus, the goals of this study were to provide teachers space in video club to discuss what student ideas were expressed, as well as the instructional practices used to draw out and respond to student thinking.

Participants

- 4536 -
The participants in video club included five middle school teachers from the same urban school (see Table 1). In addition to being at the same school, the teachers were enrolled in an urban masters degree program supported by a private university and the local urban public school district. Requirements for the two-year program included coursework within a content strand (math, science, or literacy), an urban seminar, and in-class coaching. Teachers in the study were in their first year of the program, concurrently taking their second content-focused course of the program, a weekly urban seminar, and weekly in-class coaching. Video club replaced four sessions of their content-focused course.

Table 1. Description of Teacher-Participants

<table>
<thead>
<tr>
<th>Teacher-Participant</th>
<th>Grade Level</th>
<th>Content Expertise</th>
<th>Years Teaching</th>
<th>Years at School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nancy</td>
<td>Fifth</td>
<td>Math</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Heidi</td>
<td>Fifth</td>
<td>Math</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Anna</td>
<td>Fifth</td>
<td>Math</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Sage</td>
<td>Sixth</td>
<td>Science</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Kirsten</td>
<td>Seventh</td>
<td>Science</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Video Club Format

Over one semester, I held four video club sessions. With the exception of the first session, teachers brought an uninterrupted video clip, 8-10 minutes in length, from their classroom teaching that made visible the practices identified by the focus topic. The directive was to provide a clip that represented their typical practice, and ideally, a clip with audible student talk.

Prior to the first video club, teachers read articles related to professional vision and noticing (Sherin & Linsenmeier, 2011; Sherin, 2000) to orient them to the higher-level objectives of video club. In the first session, I acted as facilitator and worked on reducing teachers’ focus on classroom environment and management, and more on trying to make sense of the content and what student talk revealed about their thinking with respect to the content.

The second through fourth video clubs included clips from the teachers’ own teaching. For each of these sessions, I selected a focus to provide guidance for clip selection: classroom talk, rigor, and multiple strategies (see Table 2 for details). Following the initial session, my voice softened as I allowed teachers to facilitate club discussions around their own clips. Discourse focused on what did occur (not what could have or should have) around student thinking revealed in the clip.

Table 2. Overview of Four Video Club Sessions

<table>
<thead>
<tr>
<th>Video Club Focus</th>
<th>Description of Focus</th>
<th>Additional comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Club 1: Introduction</td>
<td>Introductory session held to engage in the practice of noticing involving an unknown teacher (TIMSS video: <a href="http://www.timssvideo.com/78">http://www.timssvideo.com/78</a>)</td>
<td>Instructor acted as facilitator to acknowledge evaluative comments or too much attention on areas that were not noticing student thinking (such as management).</td>
</tr>
<tr>
<td>Video Club 2: Classroom Talk</td>
<td>Facilitating discussion using talk moves (Chapin, O’Connor, and Anderson, 2009)</td>
<td>Math: Discussion clip from a common lesson plan. This video club followed a lesson study format (Stigler and Hiebert, 1999). Science: open focus around discussions.</td>
</tr>
<tr>
<td>Video Club 3: Rigor</td>
<td>Students solving a problem or working through a task.</td>
<td>Math: Students solving a difficult problem. Science: Students working through a lab activity.</td>
</tr>
<tr>
<td>Video Club 4: Multiple Strategies</td>
<td>Students using multiple strategies to come to a solution.</td>
<td>Math: Students discussed their different strategies for solving one problem. Science: Students presented claims and the evidence they used to support their claims.</td>
</tr>
</tbody>
</table>

During the club, each presenter followed a rough protocol. First, she provided some context necessary for our viewing understanding. She described what content students were working on, including learning objectives and tasks. Then, we viewed the clip once with no interruptions. During this viewing, teachers jotted down notes and timestamps where interesting moments occurred, moments in the clip related to student thinking. These moments included student ideas revealed through student talk, instructional moves to draw out student ideas, teacher
responses to student ideas, or a need to interpret student thinking from work shown in the clip, such as solutions to a math problem or a drawn model. In the second viewing, the presenter started the clip from the beginning and paused whenever the clip reached a timestamp that someone wanted to discuss. Any member of the club could pause the clip at any moment.

After each video club session, teachers individually reflected on the club discussion and its impact on their teaching. The teachers did not have to reflect on discussions surrounding their clip. They could reflect on any discussion that made them think more deeply about their own instructional practice.

Findings and Analysis

To understand how a video club with a focus on student thinking could influence teachers’ practice, I focused on the reflections teachers wrote following the clubs. I analyzed teacher reflections along two dimensions: when and what student ideas were visible and expressed; and what pedagogical moves enhanced or diminished students’ ability to express their ideas.

Anecdotally, I noticed across the three video clubs where teachers brought their own clips, productive discourse occurred around student thinking. However, some club discussions made a stronger link between teachers noticing student thinking and how to respond to it pedagogically than others. With math and science teachers in the club, I expected teachers to focus on student ideas that were revealed in student talk, student writing, and student gestures with respect to content. I noticed that teachers acknowledged and addressed student ideas, but I also found that the teachers spent more time unpacking strategies used to draw out, challenge, and respond to student thinking. This focus on what teacher moves led to student talk was the primary takeaway that surfaced in their reflections.

Because of the participants’ inclination to discuss pedagogical moves, I first provide an example that illustrates reflective discourse about pedagogy, without attention to content, the most common type of discourse across video clubs. Then I share two cases that inspired stronger content-pedagogy connections around attending to and responding to student thinking.

Pedagogical Responses

Pedagogically-focused discourse was pervasive throughout club discussions. In one of Sage’s science clips, four sixth-grade students were identifying how one type of energy transformed into another type of energy looking at a number of different objects. After viewing the clip, the club discussion focused on one student’s lack of verbal contributions, a pedagogically focused discussion. Even with my nudging, the video club discussion never picked up ideas the sixth grade students offered with respect to energy. The club discussion focused on how to support collaboration when students work in groups. In Sage’s reflection, she mentioned that she gleaned several suggestions for structuring group work:

The main point I focused on for the discussion about my video was how to include one boy who did not participate at all in the group’s discussion… One major idea I liked was to give each student a question that they have to ask another student in their group throughout the discussion. Once a student answered a question they could not be asked again, therefore every student was held accountable for both asking and answering a question, which would make everyone participate in the discussion in some way.

Sage’s reflection continued with several more specific suggestions that the teachers raised during this club discussion. The reflection did not include ideas about science or students’ science thinking. This was strictly a pedagogical response focusing on groupwork that could apply to any content area.

Pedagogically-focused discourse surfaced frequently in teacher reflections. The teachers gleaned important instructional moves that they could easily apply to their classrooms. After Nancy presented her math talk discussion, she reflected that the “video club helped me to reflect on questions I asked during the lesson and the responses students gave.” In thinking about desired practices in reform science and math teaching, students should have opportunities to communicate, to explain their ideas to one another, and to question one another (NRC, 2012: National Commission on Mathematics and Science Teaching for the 21st Century, 2000). Finding ways to make student talk productive and effective can be challenging for teachers, particularly teachers working with high EL populations.

My goal was to encourage teachers to make a stronger connection between student ideas about math or science content and pedagogical moves. It could be that in the first case, science content was an uncomfortable stretch for math teachers. Science was not their area of expertise so unpacking student ideas about science could have been an unreasonable goal. Yet, these in-service teachers, new to an urban school, had a readiness to think
about pedagogy that was different than their typical practice. Regardless of content area, they could speak about how pedagogical moves facilitated the explicit expression of student ideas in general ways, as Nancy did when reflecting on her questioning strategies. Two cases, however, promoted more connected discourse between student thinking within a content area and pedagogical moves that supported the expression of student ideas. These are worth discussing in more detail.

**Using Student Work to Unpack Student Thinking**

In the first video club, Nancy, Heidi, and Anna shared classroom discussions on the same math lesson. Of all the clubs, this one had the richest discussion around student thinking. I believe this was in part due to the common lesson. In addition to that shared knowledge, the teachers brought student work samples, which afforded triangulation of student thinking across student talk and written evidence. The work samples allowed the science teachers to have a shared “text” to explore that enabled them to engage in discourse around student mathematical thinking as well. In their reflections, the teachers recalled the pedagogical moves that drew out more detailed and elaborated responses in student talk and student work.

**Focusing on One Student In-Depth**

In the second club, Sage shared a science clip that focused in-depth on a one-on-one conversation between her and a student. This clip inspired a discussion that strongly linked student thinking and pedagogy. In the clip, the student drew a food chain and labeled the organisms in her drawing. She then walked Sage through the drawing explaining how each organism was connected while Sage asked questions to probe the student’s explanation. When facilitating the club session, Sage was bothered by how she pushed this higher achieving student. She felt the only thing she knew how to do was ask “why” and “how” questions repeatedly, but that there had to be a better way to challenge her advanced students. In her reflection, Sage included one of Heidi’s suggestions, along with an example of how this suggestion would push her students to think more deeply about science:

> The main suggestion was that I should not keep advanced students working on the same project as everyone else if they had shown their competence; I needed to give them a project that challenged them. For example, I could have students who chose the same organism as a consumer share their food chains and discuss the different producers and scavengers that relate to the same consumer. These students could start a discussion about a food web and even collaborate in creating a food web using organisms from their food chains. This way students who are able to take the concept deeper can do so at their own pace and not be held back by the slower pace of the classroom.

Sage connected a specific pedagogical strategy to the content from her video clip. This allowed her to see how she could encourage students to build on their scientific understandings of food chains to construct food webs. In her clip, she was more focused on what happened and where students currently were, but the club discussion pushed her to consider where they could go next and to identify strategies she could employ to help students progress toward that next step. Focusing on pedagogical strategies in this way supports teachers in moving toward focusing on student thinking because it encourages teachers to enact practices that invite more student engagement with the content. When students have more opportunities to engage with content, it presents more opportunities for student thinking to get noticed.

**Discussion**

Overall, video clubs showed that teachers could attend and respond to student thinking. However, they spent more time discussing general pedagogy than they did in trying to make sense of student thinking within a content area. No shift in the focus of discourse occurred from one club to another. Rather, discourse depended more on the selected clip and facilitator prompts. I believe I made design decisions that could have led to this finding. A brief discussion of design tensions follows along with teacher comments to support the need for future research in these areas.

**Episodic vs. Sustained Club Sessions**

This was an episodic use of video club, not a sustained practice. It is possible that clubs on a more regular basis over a longer duration would better facilitate a shift in teacher noticing over time. In reflecting on what she would change about video club to make it more effective, Anna suggested, “having [video clubs] over the entire two
years [of the TLUS program].” While teachers agreed that the one-semester club was a good use of their time, they felt that in order for it to become a substantive component of their reflective practice, they needed more time.

**Focused vs. Unfocused**

In some club sessions, the selected topic had a narrow focus, such as talk moves during discussion. Anna (personal communication) mentioned that, “It was easier to do video club when I had a focus.” This narrow focus provided a specific lens for teachers to use when reviewing and preparing their clips. On the flipside, with such a narrow focus, they were not paying attention to other things going on in the video. In fact, Nancy reflected that she “didn’t particularly like having a focus for video clubs. I think it could be just as beneficial without a specific video focus and would allow us the opportunity to bring in clips we thought would be the most useful.”

It could be possible that providing a focus may be a club decision. For this particular club, I believe that starting with a focus helped teachers become comfortable with the video club process and practice the skill of noticing in general. Once this practice was established, perhaps we could have opened up the focus of video club to allow for more opportunities for teachers to share a range of practices and challenges. Or, the reverse could happen. Initial clubs could be left more open-ended to identify what teachers naturally attend to. Later clubs could then build up to using a more focused lens on reform ideas of teaching and learning math and science, such as attending and responding to student thinking. This is a decision that needs to be weighed against the objectives of holding a video club – is it to generally reflect on practice with others or is it to shift practice in very specific ways? The answer to this question may help inform whether a focused or unfocused approach is preferred.

**Clip Selection: Small Group or Whole Class**

Clips that focused on small group work provided more fertile ground for discussion. There was more audible and purposeful student-student talk that could be interpreted. With fewer students to focus on, teachers spent more time getting into students’ heads to make sense of their ideas. In whole class discussions, teachers focused more on students’ interactions and what they could do to manage those interactions better. Because video club was designed to get teachers to attend and respond to student thinking, I preferred an in-depth look into student thinking coming from fewer students.

**Mixed Content vs. One Content Area**

The participants in this club were located at one school. I decided to group math and science teachers together because I thought there would be value in seeing other teachers work with the same student population. However, there were occasions when I thought deep thinking about student ideas was stifled because teachers were unfamiliar with content outside their area of expertise. With a goal to help teachers attend and respond to student thinking, it may have been beneficial to keep members within one discipline. It helps to have a strong foundation of content knowledge before one tries to interpret student thinking within that content (Grossman, Wineburg, and Woolworth, 2001). This could be one reason club discussions leaned so heavily on general pedagogy and did not make a content-pedagogy connection often.

**Reflecting on Practice: Before, During, and After Club Sessions**

I wanted to establish a comfortable learning community where teachers could share their practice without being worried about being judged. I wanted them to learn from each other and develop their own teaching expertise. To do this, they needed to reflect deeply on their own practice and interpret the utility of club discussions for their own teaching. Some of this could be done during club, but I found that more self-reflection occurred before and after club sessions. Possibly because of time constraints or multiple voices, taking time to independently reflect on video preparation and club discussion was an important exercise for teacher development. In response to what elements of video club made them think about their practice, Sage responded, “Writing reflections – that part really made me change my teaching for the better. I was able to pick out exactly what was helping students and I was able to recreate that in other lessons.”

The importance of reflecting is that the ideas expressed in video club did not remain inert. Teachers actively picked them up after the club and used them to change their practice. This is what I had hoped – but given the multitude of daily tasks teachers have to do, they often do not have time to reflect deeply about their pedagogical decisions. Having club tied to a course requirement allowed me to include a reflective piece as an element of each club session. In the end, it proved to be an invaluable element, possibly the most important in getting teachers to make changes to their practice.

**Conclusion**
Once teachers get into their classroom, they often do not get to see other teachers’ practice. To align their content knowledge and pedagogical repertoire with visions of reform, teachers need opportunities to help them develop an understanding of ambitious teaching practices in math and science classrooms. Video club is a context where these discussions can happen. In this study, teachers noticed student thinking as well as pedagogical moves that fostered the explicit expression of student ideas. In their reflections, teachers discussed what pedagogical strategies they would try to implement. Important features of some video clips lent themselves to more fruitful discussions around student thinking and pedagogical responses to this thinking than other clips. Triangulating student artifacts with student talk and focusing on one or a few students in-depth helped teachers focus their attention more deeply on student thinking.

For anyone interested in designing video clubs, I recommend reviewing the outlined design tensions to help make decisions about selecting participants for video club, identifying club objectives, setting parameters for clip selection, and encouraging reflection beyond video club contact time. Video clubs do provide a space for teachers to reflect on their practice, observe different models of practice, and develop their pedagogical content knowledge. Clubs also have to be responsive to teachers’ needs to allow them to explore their concerns before they can meet our ambitious reform objectives.

References