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Exploring the Use of Slow Motion Animation (Slowmation) as a Teaching Strategy to Develop Year 4 Students' Understandings of Equivalent Fractions.

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In 2006, as a beginning teacher in a Western Sydney school, I explored slow motion animation ("slowmation") as a strategy for teaching Year 4 students about equivalent fractions. I taught at this school five days a week, teaching Kindergarten, Year 4, and Year 5. For half of the school year I taught the Year 4 class 1 day per week, in order to provide executive release for another staff member at the school. While in the Year 4 class of 28 students, I had an active role in planning the learning experiences. I aimed to use a variety of teaching strategies and utilize the technology available within the school, as well as engage the enthusiasm of the students and staff. When asked to teach the Year 4 students equivalent fractions, I decided to take a different approach to the abstract mathematical concept and assist students in creating a slowmation.

Slowmation can be defined as

> a simplified version of claymation that uses many of the same learning processes. The term comes from a combination of the words "slow" and "animation", which have been recombined to make "slowmation". This is because the purpose of slowmation is to animate a process, which is simple to produce and photograph and to show it slowly so that it enhances student understanding (Hoban, 2005, p. 3-4).

Slowmations were created by first making paper models and taking digital photographs showing small sequential movements of the models, then placing them in a digital video program to gain an animated effect. This process allowed me to use technology available within the school: a digital camera, a tripod, and laptop computers. The use of slowmation allowed me to reflect my personal pedagogy with a combination of teaching strategies: allowing students to work in groups to question and communicate, while incorporating the use of concrete materials to animate multiple representations of fractions, ultimately linking into equivalent fractions.

This use of slowmation to teach mathematics branched from my studies at the University of Wollongong, where I had seen primary science slowmations created. My thesis addressed the use of slowmation as a teaching strategy in mathematics as part of a 4-year bachelor of education degree program at the University of Wollongong, Australia. Through weekly meetings and many emails with my supervisors, Garry Hoban and Ann Baxter at the University of Wollongong, I designed suitable models to show equivalent fractions and used a trial-and-error process of photographing the models to create an effective slowmation.

Unit Design

Students learned the use of slowmation in a unit divided into six 1-hour lessons, one lesson per week. As I wrote the unit of work and reflected on its outcomes, it became apparent to me that there were three distinct phases:

- Modeling the slowmation process to the students.
- Allowing students to create their own slowmations.
- Making connections between the slowmation and the New South Wales K-6 Mathematics Syllabus (Board of Studies, 2002), other class learning experiences, and the mathematical concept of equivalent fractions.

I found the final phase crucial as a beginning teacher, as it allowed me to assess what the students had developed and assist the students in transfering their understanding and beliefs to contexts outside their slowmation.

Use of Technology

Students in the Year 4 class had access to four desktop computers located in the classroom, as well as 30 school laptops twice a week for two separate 2-hour blocks. All students had a personal email address and access to a secure school and class Web site. A technology support teacher in the school provided additional guidance and instruction to the students.

I decided that the use of technology should not only occur in these separate two-hour blocks when the laptops were present but also in normal class time. With this thought in mind, slowmation offered the opportunity to use technology to teach mathematics in what the students described as a fun, exciting, and different way. The use of slowmation allowed the students to implement other technologies in their learning with the use of a digital camera, one laptop to create the slowmation, and a digital projector to present the slowmation to the class.

Only one digital camera on a tripod was used to capture the individual frames, with a total of 724 digital photographs captured over the course of the unit. Having only one camera was a limitation that caused timing issues on occasion. I found that as a beginning teacher, time management of students needed to be monitored. I also had to create additional activities that were linked to the slowmation to keep students engaged and on-task as groups rotated around the photographing of their models. Being limited to having the class for only 1 day a week was also a limitation in many ways; however, the students were keen and enthused and began to come in at recess and lunch times on other days to ensure that the class slowmation was complete. Students offered to give up their time to use the technology and discuss how to move the models as a group.

The use of different forms of technology appeared to have a positive impact on the students with comments such as Brooke's, "I liked it because you get to use a camera," and Sam's, "We would have normally just made the shapes and put them on the wall—nothing like this." Such reflections, made at the conclusion of the unit of the work after students had made their own slowmation, indicate the different aspects of the unit that the students identified and valued.

Phase 1: Modeling

I began the unit of work by demonstrating (during the first two lessons) what slowmation is and how a slowmation is created. This phase linked the use of slowmation to developing students' understanding in two ways. First,the fraction models I created for the slowmation were concrete materials that could be manipulated and handled by students and used for discussion and questioning. Second, the slowmation process was demonstrated using a laptop and digital projector and a slowmation of multiple representations of halves. Students could observe how 10 photos of the same paper model could show small, progressive movements across the photos. With the use of a digital projector I was able to show students a series the photos in Figure 1 (see also Video 1).

I noticed that the students were able to visualize what they would do with their models when they made them. One student decided he would do it differently and instead of spinning his model he would have it bounce from side to side. This modeling allowed me to deconstruct a slowmation and the process of creating one, as well as providing me with the opportunity to connect the slowmation to the fraction models used by students in the unit of work.

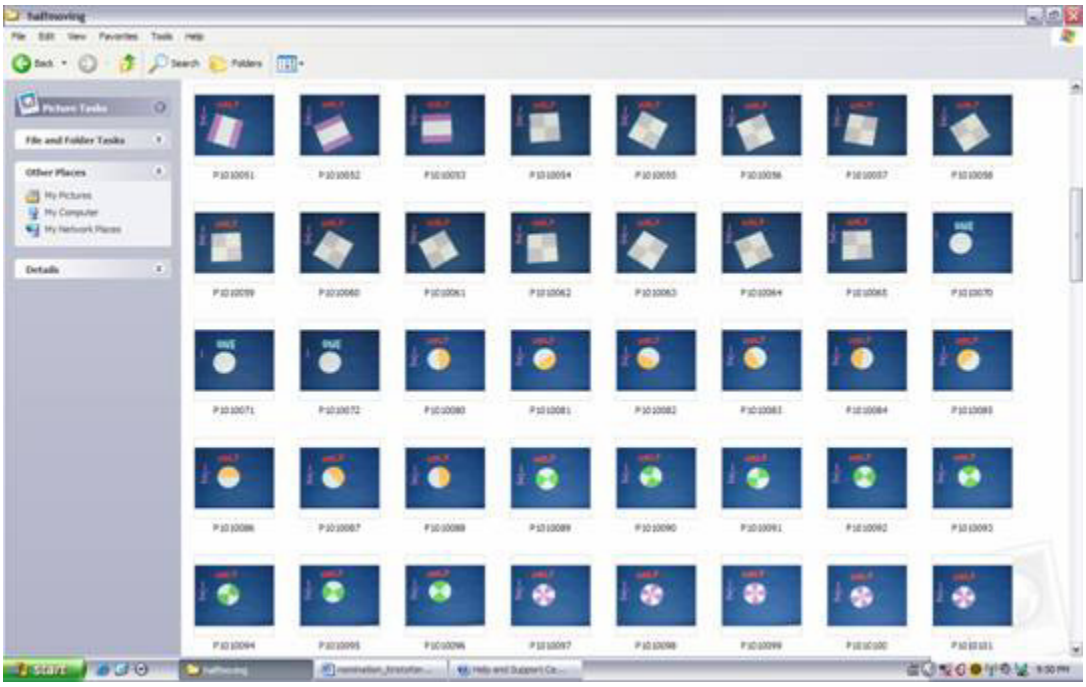

Figure 1. *Demonstrating the slowmation process.*

After the modeling phase, students appeared to grasp the concept of what a slowmation is and how to create one quite rapidly. I also found it useful to compare the slowmation process to the popular children's movies such as *Chicken Run*. One student, Thomas, was able to identify that in movies such as *Chicken Run*, "they play their frames to make the movie at about 25 frames per second." I was impressed by his and many other students' awareness of animation, reflecting prior experiences. I then explained the difference in timing between the movies and our slowmation. We would play ours at four to six frames per second, slowing down the learning process (Hoban & Ferry, 2006).

Evaluation and reflection of this modeling phase allowed me to see that students' prior knowledge had been activated, multiple representations of half had been introduced, and students' mathematical reasoning and justification of why the models represented the same amount had developed.

One example of the paper models I made to display multiple representations of half is shown in Figure 2. Figure 2 also illustrates the gradual rotation of models that creates the animated effect.

Figure 2. *Multiple representations of half used to model the slowmation process to students.*

Phase 2: Creation

The second part of the unit of work was the creation phase, in which students worked together in groups of four using colored paper to create their own multiple representations of one quarter and one eighth. The creation phase of the unit combined many teaching strategies, including the use of concrete materials, group work encouraging discussion, questioning, and peer scaffolding. Additionally, the slowmation project provided an authentic learning situation, as there was a clear purpose and audience for the creation of the slowmation. I identified early, when using the models of multiple representations of one half I had made, that the models were a key part of the creation phase and the slowmation learning experience.

Creating the models to be used was an engaging experience for students and generated much discussion among them. Thomas, when reflecting on his model before it was photographed, stated, "It looks like its not equal parts but I think if you look at how the bottom is wider than the top and you think about it, then it makes an equal neat part."

Brooke on the other hand commented that her creation experience was positive and she "liked it because you get to use a camera and you get to make things and you get to work in a group." In contrast to Brooke, Jessica, a gifted child in mathematics, commented she would have preferred to have worked alone without what she perceived as a distraction of

"people going, 'What is the answer to this, what's the answer to that?'" At times, some students had difficulty thinking of different ideas within their group and went to other groups for ideas, a successful strategy, developing mathematical dialogue and questioning.

Photographing the models was perhaps the most engaging experience for the students, and their excitement at using the tripod and digital camera was apparent. Students took care to make small, steady movements of their model and, at times, their mathematical symbols for the slowmation. The only common comment made by students about the photographing phase (apart from the use of technology itself) had to do with how long it took to photograph each model to provide the animated appearance. One group wanted to animate the written quarter sign shown in the photographs and came across difficulty when spinning the fraction resulted in 4/1 instead of 1/4. This experience alone generated mathematical discussion about the difference between the fractions and alternate ways to move the fraction without changing the value. This problem was overcome with the group swaying the fraction instead of spinning it.

Figure 3 shows a sample of some of the models the students created. These models were photographed showing small movements to create the animated spinning effect.

Figure 3. *Models created by students capturing multiple representations of one quarter.*

Students voted to create one large slowmation of all their representations (see Video 2). I downloaded all the 724 photos onto a laptop with the assistance of one student. I then used Windows MovieMaker to create an animated presentation and found the timing of the frames difficult at first. I had to find an appropriate speed to make the photos appear animated yet still slow enough to represent the multiple representations of fractions and allow for discussion. With much experimenting on the timing within Windows MovieMaker I discovered that playing the frames at 0.22 seconds each provided the desired effect.

To increase the mathematical understandings, titles were added in three sections of the slowmation to assist with the explanation of the mathematical concept and reinforce how and what the paper models were showing in relation to multiple representations of fractions. After a brief prescreening the students told me that a real animation or slowmation should have music, so we added an accompanying song.

After reflecting on the class slowmation many months later and discussing it with my university thesis supervisor, we agreed that students narrating the slowmation would also add extra depth to the presentation. However, the students seemed quite satisfied and engrossed in the "grand screening" of their slowmation and plugged in extra speakers to the laptop to ensure quality sound for the background music.

Phase 3: Making Connections

The third and final phase of the unit linked the slowmation created by students back to the mathematical concept of equivalent fractions, to other learning experiences, and to the New South Wales K-6 Mathematics Syllabus (Board of Studies, 2002). This final phase was effective in providing students with an understanding of what their slowmation had represented in terms of mathematical concepts.

Once again, I appreciated the paper models created, as we referred to them a third time to show how the multiple representations of fractions could be linked to a more abstract concept of equivalent fractions. For example, students were able to look at the slowmation models and identify that 2/8 is equivalent to 1/4. Students began with the common representation of one quarter and developed further, more abstract models.

Connections were reinforced after viewing the slowmation, with Thomas stating, "The best thing was that I already knew a fair bit but now I understand it more and it is clearer." It was interesting watching the ownership individuals and groups took in the models made and the animation of the models. Each student in the class commented on who made which model and what group worked to take the photos. This recognition indicated that the use of models and slowmation provided students with an audience and a purpose and created an authentic learning situation.

Discussion and Conclusion

As a result of the slowmation-based activities, it appeared that student understanding of fractions and equivalent fractions developed. I noted that students were able to make connections as the slowmation was created, with students organizing their models so that they progressed sequentially from common representations of one quarter and one eighth to more abstract representations. The significance of the sequencing of models was noted in the final stage, as students referred back to the slowmation and the order of photographs animating the models, while making connections to the mathematical concept. The majority of students was able to identify that the models and the representations were shown in a certain order that developed the notion of multiple representations and ultimately equivalent fractions, allowing students to view the mathematical concept developing as the slowmation progressed.

I found that this unit of work integrated the use of technology with the mathematics curriculum, as students were provided with opportunity to work in group situations. They engaged in mathematical and technological discussions with opportunities for questioning, as together they actively created mathematical models that were enhanced and manipulated in an interactive and engaging way through the integration of technology. The viewing and creation of the slowmation project provided an authentic situation for students to present their multiple representations of fractions, with the presentation being viewed by peers and other classes within the school. Further, it appeared that the use of slowmation assisted students to take ownership and pride for the models created in the slowmation and link this learning experience to more abstract situations in later lessons.

I believe that the technology used to create a slowmation project was innovative, as it provided students with an opportunity to use concrete materials and technology in a relevant, supportive context. Slowing down the process signifies each individual step of the multiple representation of the fraction process and provides an opportunity for

students to view the significance of each step. I noted that for maximum results students first watched the slowmation without comment, then viewed it a second time discussing how and why the shapes have changed and yet still represent the same amount.

While time was a large factor in the creation of a slowmation, the use of additional digital cameras and the creation of smaller, group-based slowmations would reduced or overcome time difficulties. As a second-year teacher I now look forward to using slowmation again in the classroom, maybe with another mathematics concept. I found the whole experience to be a positive, new, engaging, exciting, and valid learning experience for both the students and myself.

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