THE IMPACT OF TEACHING WITH CONTENT-BASED MATH VIDEOS

by

Jacob Scot Otto

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ABSTRACT

It has been well documented that most students enjoy watching videos, but the purpose of this action research (AR) project is to determine if the students are gathering information from the video and incorporating it into their knowledge. Students were asked to watch a video as well as perform the mathematical skill of finding equivalent values before and after watching a video. This AR also sought to assess if teaching metacognitive skills can influence student learning during the video lesson. The same treatment was performed with a video lesson with a teacher modeling metacognitive skills through a think-aloud lesson plan. Thus the AR project was a conglomeration of investigations into video-based lessons that examined the effects of teaching methods during lessons containing a video on student's math ability.

The first research question was framed in such a way to capture data about the relationship between student's ability and the impact of videos on their math ability. The second question is aimed at the teacher and the teaching technique when the teacher shows a video in class. The literature review led me to the third question and steered the instruction to a cognitive strategy based lesson. This question asked if teaching using a think-aloud method shows more growth than showing the video without explanation.

The data showed that there was only a slight improvement in the math ability after watching a content-based video lecture straight through without interruption. When a content-based video was stopped and discussed using a think-aloud lesson plan the students' ability improved only slightly better. Interestingly, the largest improvement was recorded between trials when no instruction or videos were shown about the content being tested. This seems to indicate that videos are not a convincing method of instruction even when coupled with a teaching strategy.

INTRODUCTION AND BACKGROUND

This action research (AR) project involved the use of content-based videos in the classroom. In my fifth year as a teacher in 2005, I received a video projector in my classroom. I started to find short videos to show my students as a way to expand the way information was presented. In the following years, I discovered more and more videos that were meant to not only enrich lessons but also were created to be the lesson. I was even ready to make the move to create a responsive classroom using Khan Academy as the resource library. I studied ways to be a coach of mathematics, create mini-lessons, monitor student progress, and guide children to the videos on the site. I enrolled my students and began teaching lessons in response to how they were performing on Khan Academy. It was at this point that a parent and the school director approached me to discuss this decision. They questioned the approach. This got me researching the effects of using videos in the classroom.

Researching the idea of video use in the classroom also made me reflect on my history as a teacher. My first classroom was equipped with a chalkboard and a TV on a cart in order to show videos on VHS. Later in my career, I worked at a one-to-one school where each classroom had a projector mounted to the ceiling and each student had a laptop assigned to them. Today my classroom has a SMART Board and each student uses a digital device of his or her own choosing. I started to wonder about the benefits and disadvantages of each classroom situation.

I reflected on different teaching approaches I had seen that involved lessons with videos. I started to notice that the most common teaching approach to videos is one that I have employed numerous times. This common method is a lesson that involves an introduction to the topic, an announcement that there is a video, and then

a showing of the video in entirety. I also noted that the students are passive when watching a video and the constructivist in me worried that the students were not being given the opportunity to build understanding as well as they could be if they were to be more active. A colleague modeled a more active and engaging approach to lessons with videos for me. He would entwine a video into the lesson by starting it and stopping it to ask questions, devise predictions, and encourage discussion. I wondered if the methods in which teachers show videos influence student learning. This question was later expanded to included other questions:

- What is the impact of a content-based video when used in a mathematics class?
    - What is the result of a content-based video on student's math ability?
- How does teaching technique coupled with a content-based video impact student learning?
    - Does a think-aloud technique help students incorporated knowledge into his or her learning?
    - Does student's understanding increase if the video is interrupted to encourage questions, predictions, and discussions versus teaching techniques that do not interrupt the video to question, predict, and discuss?
- How do cognitive teaching strategies used in language class support learning during content-based video lessons?

In order to assess these questions a method to collect data was developed, assessment instruments were created to collect this data, and a treatment was devised.

As part of the AR project a matrix of data collection was also created to make sure the information gathered was triangulated.

A Need for Research

I noted that many teachers use videos in the classroom and I felt that we should be informed about different ways to incorporate them into a lesson. Videos in a lesson are a common practice and student's learning with videos is often taken for granted. I believe that video usage should be evaluated and data collected on how the teaching approach impacts student's learning should be analyzed. I wanted to share my results with my colleagues, cohort, administration, students and their parents to demonstrate the role that content-based videos should take in the classroom. I was pleased to find a topic that many teachers find interesting and applicable. I also appreciate that many teachers allowed me to see lessons and take notes about how they incorporated videos into a lesson.

Another key component that made this AR project possible was the assistance of my support team. Walt Woolbaugh's guidance was invaluable throughout the project in both the writing strategies he provided and the feedback he suggested. His experience with action research was instrumental in making sure the details were put into the project. Additionally the other readers of the paper allowed me to focus the paper into what you are reading today.

CONCEPTUAL FRAMEWORK

Conducting research into the use of digital resources in the classroom exposed a demand for teachers to analyze best practice with the use of videos in the classroom. There is an abundant amount of video resources available for teachers to use, and it is important to learn about how students retain information from educational videos.

With the modern push to incorporate technology into the classroom, the constructivist theory asks teachers to find ways for students to participate while watching videos in order to construct their learning. Two researchers, Choi and Johnson studied whether video-based lessons can affect learning as well as motivation. The study revealed that students perceived video based learning to be effective yet failed to incorporate the information from the video lessons when compared to text-based instruction (Choi, H.J., & Johnson 2005).

There is plenty of research about how videos motivate students (Andersen, H., Nielsen, B. 2013; DuShane, A. 2013). However, there are few articles about studies on how digital multimedia is being used to influence student learning. In fact, a few articles mention this limitation in the literature about how to use videos in an effective way (Lewis, 1995). It is well established that children watching movies or TV are drawn to the medium. Producers of TV shows aimed at educating children, such as Sesame Street and Blue's Clues, have conducted vast amounts of research about what sort of programming attracts the attention of 3-5 year olds (Gladwell, 2002). These shows have led the way in creating a model for educational films and this has given society a large catalog of education videos. However, new research is demonstrating that even if students of all ages are engaged and express interest in the video; showing it in class does not necessarily advance student academic knowledge.

The divide between the student's engagement and how much knowledge is attained is a concern that has garnered the attention of educational research. A Ph.D. thesis written by Derek Muller from the University of Sydney, Australia noted that issues arise when students do not engage their own misconceptions when watching videos. He found that when videos are clear, concise, and easy to understand the

students invest less effort in learning. This made the students more passive in their learning and their scores between the pretest and post-test did not improve. However, when a misconception was addressed in the video the students found this video confusing but their knowledge on the post-test showed vast improvement. In a video about his findings, Dr. Muller found that if the video presents scientific concepts in a clear, well illustrated way, students believe they are learning, but they do not engage with the media on a deep enough level to realize that what was presented differs from their prior knowledge (Muller, 2014).

Muller produced studies that found multimedia which involves explicit discussion of alternative concepts (even misconceptions) is more effective for learning when compared to using videos as a summary of information (Muller, 2008). The analysis techniques looked at student opinion of the video and the information covered as well as compared test scores before and after viewing the videos. This methodology was created as a design experiment and allowed for numerous data collection techniques. He collected data on their knowledge as well as confidence in the material.

It is important to find numerous data collection techniques in order to make sure knowledge is being transferred. When studies have looked at the skills and concepts being learned from videos there is a possibility to record improvement but not comprehension. In 2004 Reiber, Tzeng, and Tribble, reported in their study that the students who received written assistance during a computer simulation of physics improved their scores within the simulation. However, when analyzing tests, concerning knowledge of physics they were supposed to learn in the simulation, showed students were not translating the information to the real world. Studies that

have methodology about implicit and explicit knowledge show the nuances of using multimedia in the classroom. This theme about hidden pitfalls of videos persists and makes for a nice challenge to find ways videos add value to a classroom.

One way to tackle the challenge of making videos useful is to regard them on par with other forms of multimedia. Multimedia is defined as any resource that combines pictures with information. Literature on this idea challenges teachers to utilize videos not as ways to fill time or purely grab the attention of the class (Kumar, 2010). During the literature review I looked at studies that included design experiments, computer simulations, TV productions, and video games. Each resource has its pros and cons but can be compared on equal footing if defined as multimedia. Derek Muller (2014) calls this the "equality principle." Kozma agrees that it is time to shift our thinking of teaching with media as a way to convey information but instead think of teaching with videos as a single source to help students making meaning as part of learning (Kozma, 1994).

This shift from using media to convey information towards a method of constructing meaning is another theme in the research. This shift asks the question about how to use a passive technology to create active learners. This is why defining digital resources as multimedia is important. An article entitled 'Talking Back and Talking Over: Young Children's Expressive Engagement During Storybook Read-aloud' helped me conceive of the treatment that I used in my research (Sipe, 2003).

I believe a next step in furthering our understanding of digital media's role in education is to see how the teaching method effects how multimedia allows students to construct knowledge. I looked for articles that made multimedia less passive and found information about interactive read-alouds (Fisher, Flood, Lapp, & Frey, 2004).

This teaching technique was used in early primary grades to teach students how to be engaged in text and pictures from a read-aloud lesson. By using the broad definition of multimedia it allowed this AR project to expose the influence of teaching methods on student learning. In the literature review conducted by Fisher et al. they found benefits in language acquisition in schools that regularly scheduled read-aloud time. They concluded that there are essential components needed in creating an interactive read-aloud. A few of these components were emphasized to the students during a think-aloud lesson. The components such as choosing appropriate media that matched the subject, level, and interest as well as stopping periodically and thoughtfully questioning the students were used.

METHODOLOGY

There were many teaching techniques to choose from as I began to formulate my methodology. Since much of my research was set around the idea of cognitive learning I looked into the methods of teaching with this as a strategy. I had been a homeroom teacher for many years and have been tasked with the job of teaching students how to be learners. In International Baccalaureate schools I have taught about cognitive skills that the International Baccalaureate Organization calls, "Approaches to Learning" (IBO.org, 2014). These are the skills that enable students to access knowledge. I used my past experience of teaching these skills to help students learn to be learners. I chose to focus my treatment on predicting, questioning, and discussing.

The second methodology I investigated was about different ways to present multimedia. This research led me to interactive read-alouds as a way to present multimedia lessons. I chose this lesson type as a way to teach students how to interact

with the information being presented. In essence this research looked into the ways that language teachers get the students to comprehend the media sources through the course of read/think alouds (Block & Israel, 2004). The treatment I employed matched this reading comprehension pedagogy. I wanted to teach cognitive strategies as a mental routine for understanding information from a video or read-aloud in mathematics. Other tasks are less structured and cognitive strategies are meant to create procedures that guide students. The treatment I devised is meant to help bridge the gap between less-structured tasks like video viewing to a more-structured task like finding equivalent values for fractions, decimals, and percentages.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

Treatment

The treatment had two trials of a content-based video lesson about equivalent values involving fractions, decimals, and percentages. The task measured the student's ability to complete the Equivalent Value Table (EVT) (Appendix B). The first questions involved converting familiar values such as 50% into decimal and fraction form. The EVT later asked more difficult questions that had repeating decimals and more obscure fractions such as four sevenths.

Each trial involved the students filling in as much of the EVT as they could before watching a video. This data was viewed as the pretest or baseline data to see how much the video helped them understand the concept of changing forms of fractional numbers.

In trial one of the treatment, students took the EVT and then watched a Khan Academy video entitled, “Converting percent to decimal and fraction.” They passively watch the video from start to finish without the teacher stopping the video. During the video the EVT was marked and rows with mistakes were marked with an “X.” After the video the students were asked to check their work from the pretest and see if they could answer more questions on the same sheet or correct any errors. The students made corrections in a different color pen so improvements could be monitored.

The treatment in trial two was done two months later in the same manner with only a few changes. The same EVT as in trial 1 was given to the students before a video was shown and marked during the video to be given back to them after the video. Another change was the video that was shown. It was another video from Khan Academy that covered converting between fractions, decimals, and percentages entitled, “Representing a number as a decimal, percent, and fraction 2.”

The major change was the manner in which the video was shown. The lesson was in the think-aloud style that discussed what to think about when watching a video. Cards were passed out to the students that were categorized as something to think about (1) before watching, (2) during watching, and (3) after watching (Appendix C). These cards were passed out before the students watched the Khan Academy video entitled, “Fraction to decimal”. The cards were read aloud when called upon to do so and the class discussed the learning technique mentioned on the cards and how it related to the video that was being shown. The students then took the end of the class to try and improved upon their work on the EVT.

The manner in which the second treatment was performed came out of my research. I modeled the treatment after lessons on effective think-alouds (Block & Israel, 2004). I took the skills that Block & Israel (2004) identified in strong readers and adapted them to video viewing. I discussed these skills by explaining to the class what a good reader or video viewer would be thinking at different moments in the video.

The treatment is known as a think-aloud type lesson where the teacher models the cognitive structure that one usually thinks about, silently, but the teacher speaks the thoughts to the class. These ideas and thinking are shared and the class also has a change to share and analyze the way they do cognitive techniques. The idea was to discuss the mathematics by saying, out loud, the questions an active learner would ask himself or herself while watching a video. The students were taught not just how to convert a decimal into a percentage but also ways to interact with a video when watching one.

The research questions guided how the data collection was conducted. In essence the AR project was to compare how teaching strategies with videos can influence student learning. The student's work on the EVT allowed me to get baseline data before watching the lecture-type video. If students finished editing the EVT early they were asked informal questions as a way to interview them and get quantitative data.

Sample

The students that participated in the treatment were in the age range of 12 to 14 and in two separate classes: one Grade 6 class and one Grade 7 class. This allowed

me to get a larger sample size and also to see the effects on a larger range of math abilities.

The students attend an international school based in Aarhus, Denmark called Aarhus Academy of Global Education. The students come from many different countries from around the world. Classes are taught in English, but many students speak a different language at home. Often they come from families who are living as expats in a foreign country or their mother and father are from different cultures. The name that has been given these types of students is 'Third Culture Kids'. There were only a few cases where a language barrier was present within conducting this study. To make sure I collected valid data from one such student I had the opinion survey translated into Japanese (Appendix D). It was also noted from the opinion surveys that the English as an additional language (EAL) learners rated videos as a learning tool lower than native English speakers.

Table 1
Demographics by Class, (N=25)

	Number of Students	Male	Female	Native English Speaker	English as an Additional Language Learner
Grade 6	14	5	9	3	11
Grade 7	11	5	6	0	11

I focused my interviews on the EAL students as a way to check the reliability of their answers. In addition, I chose Khan Academy videos and a study in math since the work shown in the video uses universal, numeric symbols.

In order to also ensure validity and reliability I created a Triangulation Matrix that is presented in Table 2. It shows the instruments that I used to collect the data and which research questions they helped answer.

Table 2
Data Triangulation Matrix

	Data Collection Methodologies					
	Pre-test	Equiv-alent Value Table	Obser-vations	Likert Survey	Warm-Up Questions	Inter-views
Research Question						
What is the impact of content-based video when used in a mathematics class?	X	X		X	X	X
How does teaching technique coupled with a content-based video impact student learning?	X	X	X	X	X	X
How do cognitive teaching strategies used in language class (think-aloud lessons) support learning during content-based video lessons?	X	X	X	X		

Two main surveys were given. One was the opinion survey which was a Likert survey asking students about their impressions of learning from videos (Appendix E). This instrument covered information about student beliefs on the validity of videos as a learning tool. It was given to the students as a single sheet of paper and they were asked to complete it by circling the answer that was their first instinct. The other survey was given throughout a period of a month and was given as a warm-up question (Appendix F). A single question would be placed on the desk for the student to answer as they came into the classroom. The Warm-Up Questions had

both guided questions that allowed students to choose from a set of options as well as open-ended questions. Both surveys allowed me to tallied answers and used the data quantitatively.

Another form of quantitative data came from the EVT where the students were asked to complete the table so that each row has an equivalent value in the form of a decimal, fraction and percentage. This quantitative data was compared to the pre and post-test on order to validate the results. The test given before the treatments and after the treatments was the same and it was a standard pencil and paper math test (Appendix G).

DATA AND ANALYSIS

The data collected to assess if teaching methods for lessons involving content-based videos influences the amount of learning indicates that there is limited impact from teaching with a think-aloud method. There was a slight increase in ability to complete the Equivalent Values Table after a think-aloud lesson but the improvement is negligible. The data also demonstrates that students are not proficient at incorporating information from videos regardless of the teaching method. For instance, the student's scores showed a more significant rise from simply waiting three months while not teaching content, than showing a content-based video and asking them to repeat the steps. It seems worthwhile for education to continue to look for ways to make learning with videos more effective.

Compiling data

The student's math ability was assessed during a pre-test that was given before any work had been done with fractions. The students were asked to solve a variety of fraction problems including finding equivalency with a fraction, a decimal and a

percent. The equivalence section in the pretest was the most valid section of the pretest due since the instrument in the treatment measured their knowledge of equivalency. Another poignant way to check pre-knowledge was from their answers on the Equivalent Values Table (EVT) before the video was shown. There were 28 blank cells in the table that the students were asked to fill in with equivalent values. Each student's table was assessed immediately before and immediately after the video section of the treatment. The range of correct answers before the video stretched from a score of zero to 27 correct. Figure 1 shows the students ranked by the amount of correct answers on the EVT before any lessons on the topic were taught.

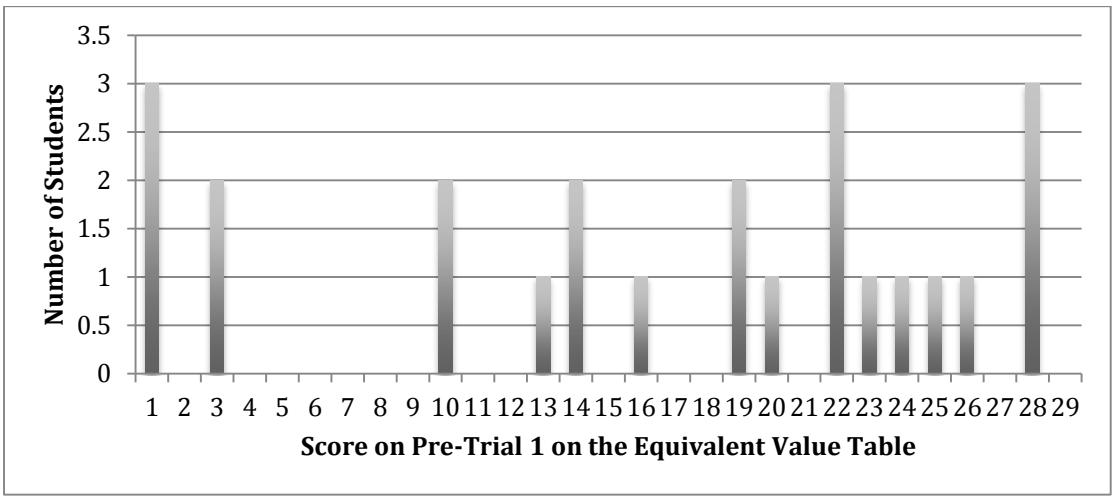

Figure 1. Score on pre-trial 1, equivalent value table, *(N*=24*).*

When looking at this as base line data it shows an even distribution of abilities across the data. The median of the data was 15 and this held true when looking at the interquartile range (IQR) as well. This indicates that outliers did not unduly influence the spread of data.

The IQR analysis from the Equivalent Value Table (EVT) before the video show that the lower six students got two or less answers correct and the top six students got 23 or more correct. A high score of 26 was reached by four students.

Not surprising the Fraction, Decimal and Percentage Test (Appendix E) showed similar results of student's abilities ranging from very little knowledge of fractions to confident and strong mathematicians. A cross-reference between these two instruments showed a direct correlation between students who had a background in fractions and their ability to complete the EVT. This shows that the two instruments were triangulated to find the students with high math ability. There was one outlier that is discussed later. Her results showed a stark improvement and when asked about her large leap in mathematical knowledge it became clear she had taken extra time to study between trials. She had learned the material before but it had been a long time since she worked with this information. After a few study sessions she went from below proficient to advanced due to her own work and not because of content-based videos.

The other forms of data collection, besides the EVT and Pre-Test, was an Student Opinion Survey about video sources (Appendix F) Likert survey (Appendix G), and as well as classroom observation and informal interviews. The information from the surveys and opinion questions collected and analyzed as quantitative data. The observations and interviews were recorded in a journal as qualitative data. During class when students were practicing their math work I moved through the class recording quotes and observations from my interactions with students. During this time I was working one-on-one with students and wrote notes in a notebook after helping them. For the passive video lesson this was easy enough to record as I was an observer on the side of the classroom. However for the think-aloud lessons, I guided the students to interact with the information in the video. This meant that I was actively teaching and recorded my observations after the lesson was concluded. The

data from the think-aloud session relied more on the student surveys as a way to collect data of student opinion.

Finding themes

An opinion survey was given over a two-month period to get a sense of how the students were using and had used technology to learn. The survey questions differed from the Likert Survey in that the Likert Survey focused on using videos during class whereas the opinion survey asked about the student's personal usage.

Each day the students entered the class and found a survey question on their desk. Some questions had lists for students to choose from and other questions were open-ended. Figure 2 shows that when the students chose from a list of resources that they could use to learn a new topic, video was the method that was chosen the most. This seems to indicate that students enjoy watching videos to learn which confirms the research that states that videos engage students

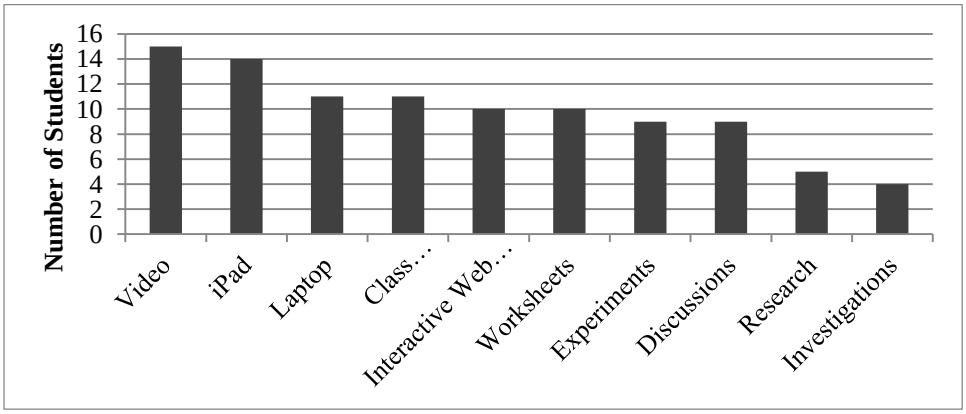

Figure 2. Resources students choose to learn from: from a list, *(N*=29*).*

However, when the list of resources was removed from the question the answers changed. An open-ended question ask, "What are some ways you have used technology to learn?" and Figure 3 shows the videos is no longer the method that is

chosen the most. Figure 3 shows that videos are still being used but when compared to general searches and specific math sites videos were only chosen by seven students.

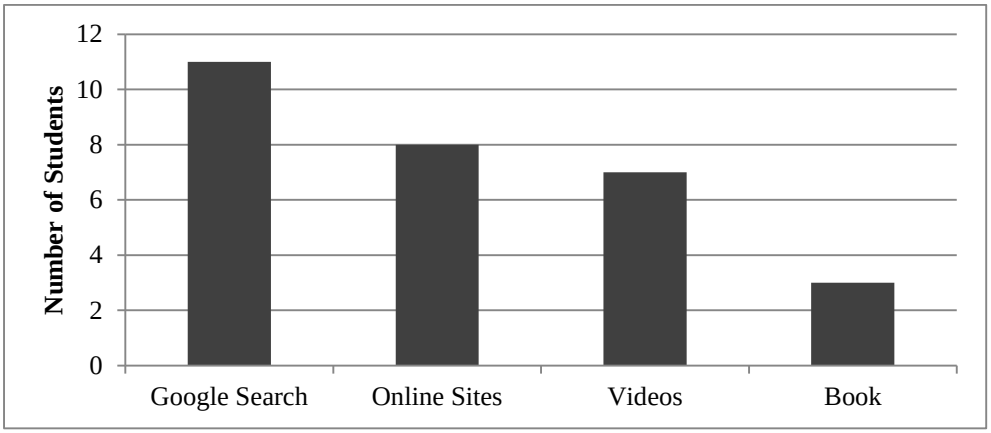

Figure 3. Resources students choose to learn from: open ended, *(N*=29*).*

Videos slip further from the top when students were asked what they do if they do not understand a math concepts we are studying. This question was asked about what they do at home and separately what they do at school. Zero students answered that videos is something they would use if they were at school and did not understand a math concept. The students were allowed to answer as many methods as they like and Figure 4 shows the combined answers of what they would do at home and at school if they did not understand the math concept. The sample group was 29 students and since they were asked about home and school the maximum that a method could occur is 58 times. Seventy-nine percent of the students answered that they would ask an adult (parents or teacher) and only 3% said they would watch a video for help.

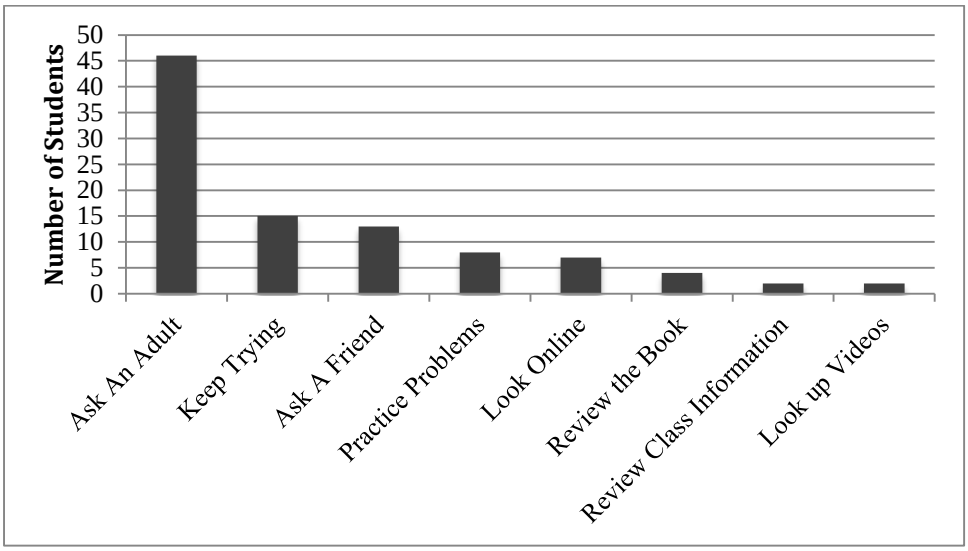

Figure 4. What resources a student would use if they do not understand, *(N*=29*).*

The opinion survey illustrates that students will use multimedia as a learning tool if guided towards video usage but if left to their own devices. This indicates that videos are not the chosen method of learning.

The Likert Survey was the other method used to get an understanding about student opinion of video usage. This survey also indicated that there were a variety of ideas about video usage. This survey centered on how content-based videos impacted their learning and what teaching methods work best when coupled with content-based videos.

The answers on the survey confirmed again that students enjoy watching videos during class time. Student opinion about video use is shown in Figure 5 as a stacked graph. Each column shows a favorable opinion of learning with videos. An overwhelming 96% percent of the students said they like watching videos in class (*N=29*). This percentage drops to 69% when asked if they consider videos to be educational yet 94% believe videos are a good use of class time (*N=29*).

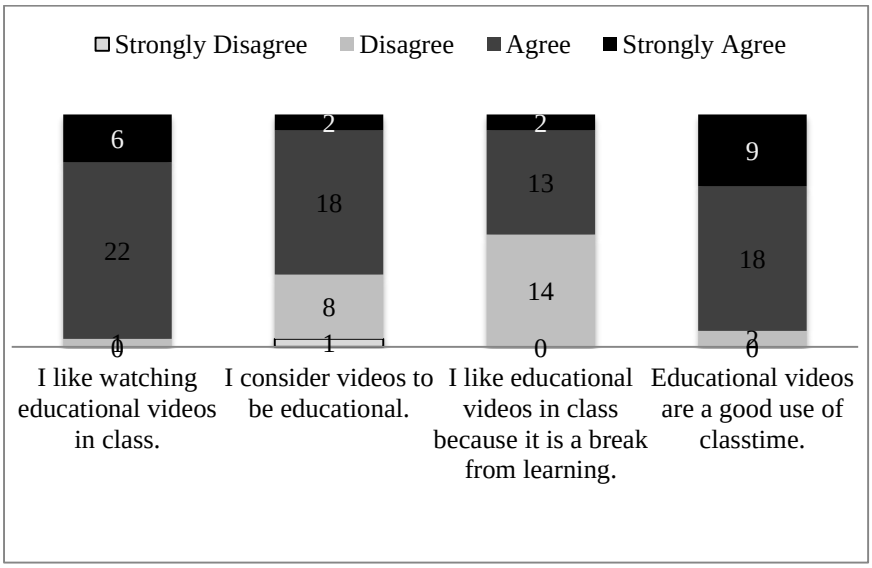

Figure 5. Student opinion of videos during class time, *(N*=29*).*

The student's surveys indicate that though they like watching videos and find them beneficial they do not consider them to be overly educational. This theme became clearer in the student survey when teaching techniques was added to the questions. The least popular teaching technique was allowing students to talk with classmates. Only 41% of the students agreed that talking to their peers, during a video, would help them learn (*N=29*). Shaurya, an engaging and verbose student, remarked that he likes to talk during videos but is often shushed by his classmates. There was a more favorable opinion of stopping the video; 65% of the students agreed that this method helps them learn (*N=29*). An endorsement of 83% of the students believed that discussing the video after watching a video helps them learn (*N=29*). These results are shown here in Figure 6 as a stacked graph.

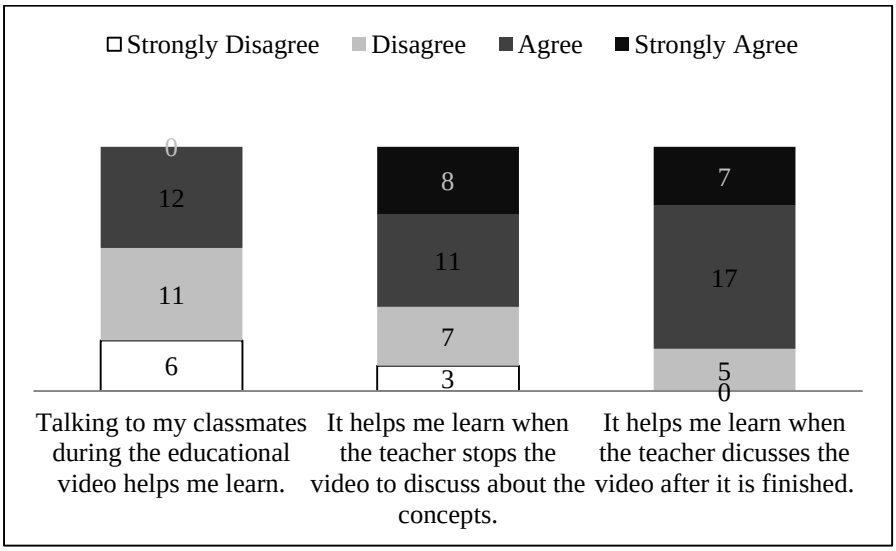

Figure 6. Student opinion of teaching techniques with videos, *(N*=29*).*

The treatment compared the impact from videos on student learning if there was no discussion or if dialog was made obvious via a think-aloud during a video. This data was collected from the EVT that was given before and after the treatments. The treatment was conducted in such a way that while the students watched the content-based video their EVT was corrected. An x was placed on the side of the row if there was an incorrect answer in the row. The students received the 'graded' table back and had a chance to correct any errors. Table 1 demonstrates that no students received a lower score after the videos were shown. In fact, the data shows that 14 students in the first trial and 16 in the second trial found errors and corrected them. This seems promising for showing that students learn from videos. However, a child would have had to erase a correct answer and replace it with an incorrect answer to lower his or her score. There was one incident from the study where a student did indeed changed a correct answer to an incorrect answer however she revised three other answers properly to show an improvement of two more correct answers.

Table 3
Number of Student's Whose Scores Differed After a Lesson with a Content-Based Video, (N=25)

Student achievement	Trial 1	Trial 2
Increase	14	16
Stay the Same	11	9
Decrease	0	0

This means that a score of no difference essentially means that a student did not learn anything from watching the Khan Academy videos. The table below shows the number of students who had the same amount of correct answers after watching the video. Twenty-five students participated in both trials and in Trial One; eleven students did not show any improvement at all whereas nine students did not improve after the think-aloud trial. This means that 56% improved after watching the video and 64% improved after the think-aloud trial (*N=25*). These were students who were able to edit their work and show an increase in math knowledge.

Though these numbers seem to suggest the teaching method increased student learning by 8%, there could be other influences (*N=25*). If the correct answers students gave before the treatment, are compared interesting information arises. The average correct answers between trial 1 and trial 2 increased. Table 2 shows the scores, or correct answers given, for the pre and post trials for both treatments. Both treatments show an increase but also it is work noting that there is also an increase between trial one and trial 2.

Table 4
Correct Answers on the Equivalent Values Table for Both Trials, (N=25)

	Pre	Post	Increase
Correct Answers Trial 1	352	386	34
Correct Answers Trial 2	425	467	42

There was a two-month difference between the two trials and no fractions were taught between the treatments. One student was new to the school when the first trial was given and she did not get any correct answers before or after the video. She wrote a note that said, "I'm so sorry sir, I haven't done fractions in a long time. I will definitely review." Her score between trials increased from 0 to twenty-four but even when you remove her data as an outlier the difference between the two pre-trial score is 49. This increase is higher than both the increases from the treatment.

At the start of the second trial the students showed more mathematical ability to find equivalent values than at the start of the first trial. On average the students answered 1.96 more correct on EVT before trial 2 than in trial 1. This difference of 1.96 more correct answers at the start of the treatment was compared to the mean increase immediately after watching the first video. The class average showed an increase after watching the video straight through but the increase was lower than waiting two months to retake the EVT. After watching the video the class had an average of 1.36 more correct answers. The increase between the two trials was greater than the increase from watching a video.

Table 5
Average Increase of the Correct Answers of the Whole Class, (N=25)

	Class Average Increase of Correct Answers
At Start of Trials (without the outlier)	1.96
After Trial 1	1.36
After Trial 2	1.6

The other information from the EVT was the increase of correct answers from the pre treatment to the post treatment as seen in Table 2. This comparison was the data that was most directly tied to the research question. It is the quick answer to see if teaching technique in conjunction with a content-based video influence student

learning. At first glance of Table 2 we can see that a video coupled with a Think-Aloud lesson showed a greater increase in correct answers. Eight more correct answers were given than if a video was shown without teacher interruption.

Upon further inspection of the normal distribution found an average increase of 8 correct answers after watching the video. Eight correct answers is less than the standard deviation. The standard deviation is calculated to be 9.5 correct answers which would be needed to show significant growth. The standard deviation and variance was found both treatments for before and after the treatment. Figure 7 and Figure 8 show the distribution about the mean for the two trials. Very little growth is shown between the pre and post in both trials.

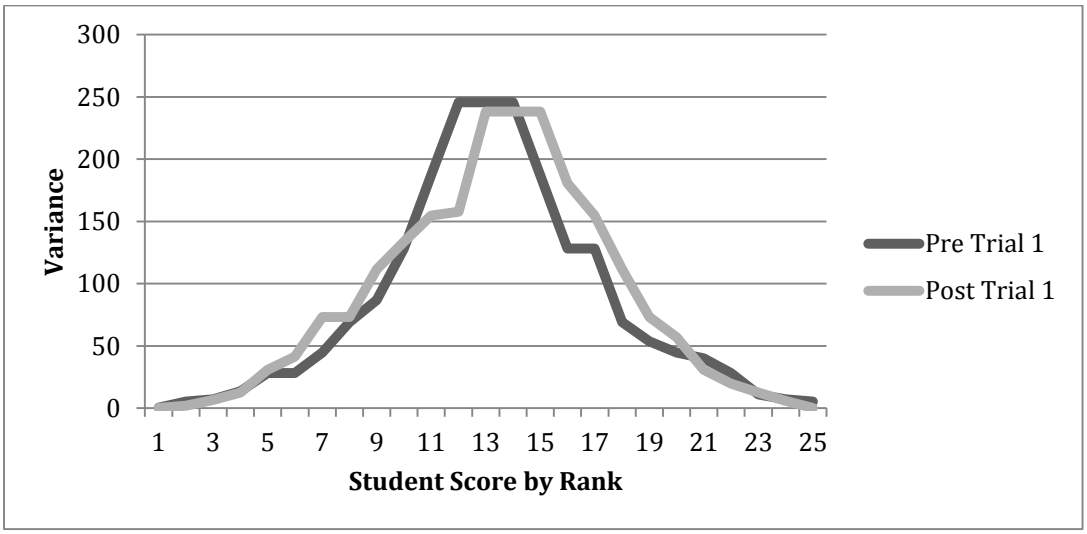

Figure 7. Distribution about the mean of students' scores trial 1, *(N*=25*).*

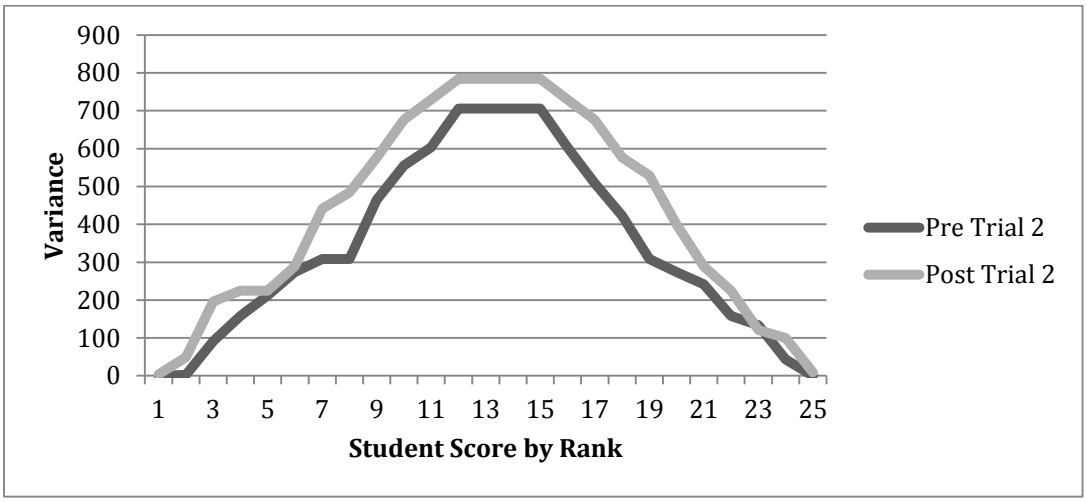

Figure 8. Distribution about the mean of students' scores Trial 2, *(N*=25*).*

The standard deviation when calculated for Trial 1 was 9.2 pre and 9.5 post and the standard deviation for trial 2 was figured to be 18.8 and 21.1. The student increase did not exceed the standard deviation. In fact no student in the Action Research data showed an increase of more than 6 except the one student who was quoted earlier and then said, "I will definitely review." Her score went up 24 points after she refreshed her knowledge of fractions that she had studied previously. This would is the only score that moved up one standard deviation and her interview indicates that it is due to studying at home and not from watching videos.

It should be stated that moving up one standard deviation of 10 additional correct answers is a big improvement on a test with a total of 28 correct answers. In fact, there were 9 students in total whose pre-trial score was in the twenties which means their improvements had to be looked at in a different manner. These top students had a smaller margin of improvement recorded due to the instrument that was used. The analysis of the top math students indicated that their improvement was due to correcting simple errors. It is possible that the video helped them with finding

the errors but their pretest and pre-EVT indicated they mostly knew the content and did not learn a new skill.

Due to the fact that the instrument has a maximum correct it was thus more important to look at the students who showed the largest increase in their score. The largest increase was an improvement of six more correct answers and there were three students who reached this mark. These three students are all in the Grade 6 class and scored high on their pretest. However, they are not the students who scored the highest on the pretest. This seems to indicate that if there are students who would benefit from content-based videos it is students who have a strong background in a topic but have not yet met mastery. There are exceptions to this as well. Shaurya, the student mentioned earlier, is a strong mathematician but not at the top of the class. He was still converting the fraction 4/7 to a decimal as 0.47 on the EVT in trial-2. It is these sort of misconceptions that persist even after students watch two videos, that Dr. Muller (2008) says need to be addressed in the video in order to reach the student. Many times the students who are already strong in math also need to be confronted with their misconceptions in order to move to mastery.

INTERPRETATION AND CONCLUSION

The students on a whole did not show a significant gain in knowledge from watching a content-based video (see Figure 7 and 8). This seems to indicate that students are not learning new content or skills form watching a video. This held true even when an attempt was made to integrate the video into a think-aloud lesson. Though it should be said that there were modest gains and more studies could be performed to see if other types of lessons integrating content-based videos could increase these modest gains.

In response to the first question on the impact of content-based video when used in a mathematics class, the data shows that videos had little impact on student's ability to perform a mathematical skill. After analyzing the data and considering the impact of a content-based video when used in a mathematics class, it can be said that videos, only slightly aid student learning (see Figure 7). The results showed that a content-based video gave students modest improvement with their math ability (see Table 4).

Looking at the second AR question regarding the impact of coupling a teaching technique with a content-based video impact student learning, the data also shows is method had a minor impact on student's ability to perform a mathematical task. After looking at the data it can said that the teaching technique coupled with a content-based video also showed only modest improvement in students' math ability (see Figure 8). The second treatment stopped and started the video to discuss the information and guide student thinking. This method did not show significant gains in students' math ability.

The third question involved the use of language class methods such as think-aloud lessons during content-based video lessons. The data from the Warm-Up questions indicates that students do not appreciate interruptions during a video (see Figure 6). This coupled with results found for the first questions shows that the think-aloud method did not work. The data from this AR project would direct me to say that metacognitive strategies employed in language classes such as think-aloud lessons did not seem to transfer over to content-based video lessons after one trial. However, more research is needed to completely prove or disprove if strategies that are good with read-alouds are equally good with video lessons. This conclusion is

limited to a single assessment on one teaching technique. It might be worth trying a longitudinal study on teaching metacognition and its effects on student learning from content-based video lessons.

An interesting conclusion that was uncovered in AR is the data from the pre-trial assessment. The largest gains in the students' ability were found when comparing the two pre-trial scores. This was essentially comparing the gains that the students' had during the two-month hiatus between treatments. This increase could be attributed to a few factors. One is that even though the classes did not study fractions directly there was instruction on decimals in the 6th grade class and geometry in the 7th grade class that would be adding to the overall math ability of the students. However it could also mean that the information in the video takes awhile to be assimilated with their math knowledge. Lastly and most simply, the increase could simply be timing. The day the students did the treatments could have students are two months more mature and more ready to learn.

VALUE

The purpose of the AR project was to investigate how the manners in which students are taught to watch a video influence their learning. It is important to note that students will learn from and pay attention to videos. So really the question was about the teacher's influence in the process. I learned from my research that the outcomes of learning from videos are not always positive. In a study performed at the University of Sydney, Australia student's misconceptions were actually solidified by informative videos instead of replaced (Muller, 2008). Students in Muller's study were more confident in their misconceptions about gravity after watching a video that was made to inform them the students about the way gravity really works. He found

that the type of video that helped student learning the most were videos that directly confronted the misconceptions.

My findings will impact how I structure a lesson involving videos. I will continue to teach the skills of predicting, questioning, and discussing which will help students become better overall students even if this study showed that it does not help improve their absorption of knowledge from videos, in the short-term. I believe that learning this skill is something reflective learners do and will help them to be a better student even if the data shows it did not help them be better mathematicians.

I also see a value in continuing to test out different teaching methods to see how they impact student learning. The results show that we are more than just subject teachers. At the start of the AR project the focus was on student knowledge in mathematics but the path of action and research led to teaching cognitive skills. It is important to recognize that math and science teachers are also language teachers as well as study skills teachers. The data from the Warm-Up questions showed that students like watching videos but do not use them as educational tools. I see this as an opportunity to teach student how to use a variety of sources to find information. The results reiterated the need for teachers to find time to teach these skills along with the content. Any lesson plan: an activity, a video-based lesson, a lecture, or instruction involving a SMART Board still requires constructing knowledge. The next steps require the teacher to analyze how to teach the cognitive skills to construct that knowledge.

Other next steps include looking into the integrity of the videos. More questions can be asked that might allow for more research into the impact of content-based videos on student learning. Television producers have studied how to keep the

attention of young children so logical next step would be to find ways to teach them while you have their attention. Dr. Muller founded a YouTube channel called Veritasium where he has created videos that expose misconceptions in science. This is a great first step in creating a library of quality learning videos. With further research, the educational profession might also find additional ways to improve the value of content-based videos.

As for the impact on the students themselves, the results are transferable to many of the student's lives. Middle school aged students are digital natives and have lived their whole lives in a world with computers. Many of the students are never far from their own personal devices that have access to the Internet. Much of their free time and study time is spent on these devices and some of that is watching videos. With so much time being spent interacting with digital information, there is value in finding the best way to create knowledge from this information. As the survey showed, the students have opinions of what helps them learn and what is a hindrance when watching videos. Teaching them to be better connected to their own ability to learn can only enhance their capabilities to incorporate knowledge from videos. As an educator, I look forward to continuing this study and looking for the best possible way to help students be learners when they are watching videos.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
c/o Immunology & Infectious Diseases
Montana State University
Bozeman, MT 59718
Telephone: 406-994-6783
FAX: 406-994-4303
E-mail: cherylj@montana.edu

Chair: Mark Quinn
406-994-5721
mquinn@montana.edu
Administrator:
Cheryl Johnson
406-994-6783
cherylj@montana.edu

MEMORANDUM

TO: Jake Otto and Walt Woolbaugh

FROM: Mark Quinn, Chair Mark Quinn CTJ

DATE: November 10, 2014

RE: *"Content-Based Video Usage in a Middle School Classroom"* [JO111014-EX]

The above research, described in your submission of November 10, 2014, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

X (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

X (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

EQUIVALENT VALUE TABLE

FRACTIONS	DECIMALS	PERCENTAGES
1/4		
	0.5	
		75%
	1.5	
FRACTIONS	DECIMALS	PERCENTAGES
2/3		
	0.1	
		200%
1/1		
FRACTIONS	DECIMALS	PERCENTAGES
		15%
	0.35	
1/9		
FRACTIONS	DECIMALS	PERCENTAGES
4/7		
	2.4	
		0.5%

APPENDIX C

THINK-ALOUD LESSON CARDS

1 Overview of the video. 	1 Look for important information. 	1 Connect to the big idea.
1 Activate relevant knowledge. 	1 Put myself in the video. 	2 Revise prior knowledge and predict.
2 Recognize the videos style. 	2 Determine the contents meaning. 	2 Ask questions.
3 Notice novelty in the video. 	3 Relate the video to my work. 	3 Anticipate use of knowledge.

APPENDIX D

STUDENT OPINION SURVEY (JAPANESE)

Name_____
Please complete the survey by reading each statement and circling how much you agree with the statement.
下記それぞれの質問に対して自分の意見に近い答えを丸で囲みなさい。

1. I like watching educational videos in class. 授業で教育番組を見るのが好き。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. I like watching educational videos during my own free time.
   自分の空いている時間に教育番組を見るのが好き。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. I get good information from educational videos.教育番組から学べることが多い。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. I am able to stay focused during educational videos. 教育番組を集中してみていられる。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. I consider videos to be educational. ビデオを見ることは教育的だと思う。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. My learning depends on how well the educational video is scripted and created.
   教育番組の内容や作り方によって学べることが変わる。
   Strongly Disagree Disagree Agree Strongly Agree
   全くそう思わない そう思わない そう思う とてもよくそう思う

1. I like educational videos in class because it is a break from learning.
   勉強しなくていいので授業中に教育番組を見るのが好き。
   Strongly Disagree Disagree Agree Strongly Agree

全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. Long educational videos are better than short educational videos.
長い教育番組の方が短い教育番組より良い。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. Short educational videos are better than long educational videos.
短い教育番組の方が長い教育番組より良い。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. Talking to my classmates during the educational video helps me learn.
教育番組を見ている間、クラスメートと話すことは理解を助ける。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. It helps me learn when the teacher stops the video to discuss about the concepts.
途中で先生が内容について話し合うために一時停止することでよりよく理解できる。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. It helps me learn when the teacher discusses the video after it is finished.
終わった後に先生が内容について話すことでよりよく理解できる。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. I enjoy educational videos that include a teacher teaching a topic like a lecture.
教師が実際に授業をしている教育番組を見るのも好き。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. I enjoy educational videos that highlight real world examples.
現実世界の例を挙げている教育番組が好き。

Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. I enjoy educational videos with a variety of pictures.
色々な場面が出てくる教育番組が好き。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. Educational videos are a good use of class time.
教育番組を授業中に見ることは良い。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. Educational videos make good homework assignments.
宿題で教育番組を見ることは良い。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

1. I am able to learn from educational videos.
私は、教育番組から学ぶことができる。
Strongly Disagree　Disagree　Agree　Strongly Agree
全くそう思わない　そう思わない　そう思う　とてもよくそう思う

APPENDIX E

STUDENT OPINION SURVEY

Please complete the survey by reading each statement and circling how much you agree with the statement.

1. I like watching educational videos in class.
   Strongly Disagree Disagree Agree Strongly Agree

2. I like watching educational videos during my own free time.
   Strongly Disagree Disagree Agree Strongly Agree

3. I get good information from educational videos.
   Strongly Disagree Disagree Agree Strongly Agree

4. I am able to stay focused during educational videos.
   Strongly Disagree Disagree Agree Strongly Agree

5. I consider videos to be educational.
   Strongly Disagree Disagree Agree Strongly Agree

6. My learning depends on how well the educational video is scripted and created.
   Strongly Disagree Disagree Agree Strongly Agree

7. I like educational videos in class because it is a break from learning.
   Strongly Disagree Disagree Agree Strongly Agree

8. Long educational videos are better than short educational videos.
   Strongly Disagree Disagree Agree Strongly Agree

9. Short educational videos are better than long educational videos.
   Strongly Disagree Disagree Agree Strongly Agree

10. Talking to my classmates during the educational video helps me learn.
    Strongly Disagree Disagree Agree Strongly Agree

11. It helps me learn when the teacher stops the video to discuss about the concepts.
    Strongly Disagree Disagree Agree Strongly Agree

12. It helps me learn when the teacher discusses the video after it is finished.
    Strongly Disagree Disagree Agree Strongly Agree

13. I enjoy educational videos that include a teacher teaching a topic like a lecture.
    Strongly Disagree Disagree Agree Strongly Agree

14. I enjoy educational videos that highlight real world examples.
    Strongly Disagree Disagree Agree Strongly Agree

15. I enjoy educational videos with a variety of pictures.
    Strongly Disagree Disagree Agree Strongly Agree

16. Educational videos are a good use of class time.
    Strongly Disagree Disagree Agree Strongly Agree

17. Educational videos make good homework assignments.
    Strongly Disagree Disagree Agree Strongly Agree

18. I am able to learn from educational videos.
    Strongly Disagree Disagree Agree Strongly Agree

APPENDIX F

WARM-UP OPINION QUESTIONS

Guided Questions:

Given the choice to learn math using any way you wanted which method(s) would you choose?

1. class notes/lecture
2. worksheets
3. iPad
4. discussion
5. experiments
6. investigations
7. research
8. laptop
9. video
10. interactive web sources

Who do you think knows more about technology: teachers or students? Why do you say that?

On a scale of 0 to 10, how good are you at using technology to learn?
Zero being not at all and 10 being excellent.

0…1…2…3…4…5…6…7…8…9…10

Learning with videos makes learning (circle one)….easier…harder… is the same as…learning from a book.

<u>Open Ended Questions</u>

What are some ways you have used technology to learn? Did it work for you, why or why not?

If you were given the option of using technology to help you learn math concepts better, what tools would you choose, and how would you use them?

What do you do if you don't understand a math concept we are studying?

At home

_____

_____

_____

_____

At school

_____

_____

_____

_____

APPENDIX G

FRACTION, DECIMAL, AND PERCENTAGE TEST

Complete the following questions.

1) **Fill in the blank spaces in the table below so that each of the values along the row shows the same amount. (Equivalent)**

FRACTIONS	DECIMALS	PERCENTAGES
¼		
	0.35	
		15%
¾		

(8)

2) Simplify the following fractions: (4)

$\frac{4}{8} =$

$\frac{12}{16} =$

$\frac{42}{56} =$

$\frac{18}{108} =$

5) Fraction of a quantity, find the

following: (5)

$\frac{1}{2} of\ 90 =$

$\frac{1}{6} of\ 144 =$

$\frac{3}{9} of\ 57 =$

$\frac{3}{4} of\ 96 =$

$\frac{5}{8} of\ 104 =$

6) Decimals, answer the following questions: (4)

$9.01 + 2.49 =$

$10 - 3.75 =$

$2.83 \times 4 =$

$1.44 \div 6 =$

7) Percentage of a quantity, find the following: (5)

$50\% \; of \; 400 =$

$10\% \; of \; 800 =$

$20\% \; of \; 275 =$

$1\% \; of \; 45 =$

$23\% \; of \; 200 =$

8) In the new brochure golf items are 15% more expensive than last season. What is the new price of golf clubs which used to cost €400? (2)

9) $\frac{19}{37}$ cannot be simplified any further – why not? (2)