IN WHAT WAYS MIGHT FLIPPED INSTRUCTION USING TECHNOLOGY SUPPORT STUDENTS' SUCCESS WITH WORD PROBLEMS?

by

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Abstract

This study explored whether the implementation of technology-based flipped instruction might have any effect on students' success with mathematics word problems. During the study, two 5th grade classes were asked to fill out pre- and post-questionnaires describing their attitudes and opinions towards technology in the classroom, math word problems, and major academic subjects in general. There were also two assignments that compared the results of instructional methods that were linked to each assignment: flipped instruction and traditional instruction. Evidence showed that flipped instruction had a possible positive impact on students' performance on math word problems.

Chapter 1: Conceptual Framework

Word Problems: A National Achievement Challenge

Reading and mathematics may come naturally for some. For others the subjects can seem like a foreign language that mentally drains them due to frustration from failure.

When it comes to Math and English Language Arts in a large city like New York, test scores in grades 3-8 demonstrate how much of a problem these subjects really are for students. In 2012, in traditional New York City schools, only 60% of the students received a grade of a 3 or a 4 out of 4 on the Math state exam. In the rest of New York State, only 67% of the students received grades of a 3 or a 4 (NYC Department of Education, 2012). In English Language Arts, the scores were worse. In 2012, in traditional New York City schools, only 46% of the students received grades of a 3 or a 4. In the rest of New York State, only 59% of the students in grades 3 through 8 received scores of a 3 or 4 (NYC Department of Education, 2012).

Bringing both reading and mathematics together in the form of a mathematic word problem could compound students' frustration. Math and reading are two problem areas in today's schools, and when combined in the task of word problems, outcomes are dismal. According to National Assessment of Educational Progress (NAEP), only 7% of 4^{th} graders can masterfully solve a word problem involving time (NCES, 2012).

Schools, teachers, principals, educators, and parents are all trying to figure out why so many students are doing poorly in Math and English Language Arts. Educators are trying to figure out how to reverse the trend so that students can comprehend information, apply it, and make the information their own.

Pedagogic Shifts To Improve Achievement

A possible reason for the lack of success could be current teaching techniques. In today's classrooms, many teachers' use a general approach for teaching. Teachers often lecture or give out the information that they want the students to learn; afterwards the teacher sends students off with an assignment or homework that they will use to apply the information that they just learned.

The purpose of this study will be to explore whether or not using the website www.khanacademy.org might increase the knowledge and understanding of a given subject such as word problems compared to a teacher-taught lesson. Khan Academy is a rapidly growing website started by Salman Khan in 2006 that gives in-depth step-by-step instructions through videos that show how to do math problems among other things. The Khan Academy has an extensive range of videos on lessons that students can go to if they want to learn a certain topic.

These videos provide direct instruction that can be used for the purposed of flipped instruction. Flipped instruction is the reverse of the usual everyday teaching method that is seen in schools. In general education, when a new topic is introduced, teachers present the "how to" portion in class, sending students home to apply their knowledge in their homework. In flipped instruction, students might get the "how to" portion for homework through a site like Khan Academy and then come back and apply their knowledge at school in the classroom (Herreid & Schiller, 2013). The teacher in the classroom can thus help anyone who is having trouble applying concepts using one-on-

one approach instead of using class time lecturing the whole topic to the entire class, then hoping students can apply the lesson to practical matters.

What this study explored is whether or not reversing that technique, or "flipping" instruction, had any affect on the outcome of students' success with math word problems. Instead of the teacher lecturing and giving out the information that he/she wanted the students to learn in school, he/she had the students learn that material at home for homework through an online video of a lecture. Then the next day, the teacher had time to show the students how to apply the knowledge that they just learned at home to everyday problems and situations.

Throughout the years, there have been many newly invented and introduced technologies that have been later defined as "disruptive technologies." Disruptive technologies are defined as technologies that have interrupted or diminished a previous market or way of doing business (Commitee on Forecasting Future Disruptive Technologies, Air Force Studies Board, Division on Engineering and Physical Sciences, & National Research Council, 2010). Disruptive does not have to mean a negative term though; in the context of disruptive technology, it could mean that something is creative, innovative and/or transformational (Shulevitz, 2013). Some examples include digital cameras compared to film-based cameras and telephones compared to telegraphs. Digital cameras virtually shut down the film camera industry by increasing the number of photos that could be taken in a single session along with being able to view the photos that were just taken directly afterwards from the camera itself. They also cut down the developing and servicing time to be virtually instantaneous. The telephone overtook the telegraph market by adding voice and language to long distance communications where the

telegraph only had code that needed to be interpreted and then sent back in the same fashion. Disruptive technology in the classroom is being brought forth to transform the education system powered by technology so that learners receive more personalized and engaging learning experiences, and where assessment, teaching, infrastructure, and productivity are redefined (Horn & Mackey, 2011).

Some argue that Khan Academy and flipped instruction may potentially represent a disruptive technology for education. There is a possibility that if Khan Academy can show enough success in its teaching techniques that teachers would not need to lecture or have to introduce and teach new material to students, which many teachers have been doing every day in their classrooms for decades. According to Christensen, Horn, and Johnson (2008), public school enrollments in online classes have skyrocketed from 45,000 back in 2000 to roughly 1 million in 2008. If flipped instruction became disruptive to education, the teachers' jobs would not necessarily be diminished, but the kind of work that would be in the classroom could possibly be radically changed. As Shulevitz (2013) notes, "disruptive" can also mean creative, innovative, and/or transformational; such a change could be positive. For example, since lecturing and introductions to new material would be done at home for homework, teachers might work one on one with students to help them apply their previously acquired knowledge that they received at home. A resultant change might be a potential drop in the demand for textbooks, coupled with an increasing demand for technology resources in the classroom and at home.

The Confidence Factor

Student achievement is not solely a factor of an instructional pedagogy. Some students may have preferences towards math and/or reading, perceiving themselves to be strong in one area or another. Student expectations can have a powerful impact on achievement. Carol Dweck (2012) has researched students' mindsets, showing powerful effects:

> "Much research has shown that when people hold a fixed mindset about their own traits, such as their intelligence, they tend to avoid challenges for fear of showing themselves to be unintelligent. They also tend to show less resilience in the face of setbacks; that is, they interpret the setbacks as implying a lack of ability and become discouraged or defensive. In contrast, those who believe their qualities can be developed tend to seek challenging learning opportunities and show resilience in the face of setbacks—setbacks are not indictments of the self but, rather, are integral parts of learning".(p. 615)

For example, students who consider themselves "bad" or have a negative attitude towards English Language Arts and/or math can psychologically diminish their efforts for success. Conversely, students who consider themselves "good" at English Language Arts and/or Math and go into each activity and lesson with a positive attitude, in theory, will do better in those subjects than those with negative attitudes. Being "good" could also put a child into a fixed mindset.

> "Individuals with a fixed mindset believe that a certain amount of intelligence was given to them at birth and that they will never have any more. They believe that when they have to make an effort to learn, it means they aren't smart enough; they become discouraged and give up when faced with setbacks; and they value

> looking smart above all else. Rather than risk failing, they often avoid challenges and engage only in tasks they know they can perform well" (Blazer & Miami-Dade County Public Schools, 2011, p. 1).

Even more important, students who see effort as key to success can outperform both those who think they are "bad" or "good" at something.

One of the ways to increase confidence is to provide students with successful learning experiences. Research shows that mastery of smaller units of information can build confidence (Fast et al., 2010). Khan Academy offers students the possibility to do just that because the website allows the students as much time as they need in order to understand and master each task at hand. Perhaps the apparent success of the website has to do with the website's teaching technique and how the material is delivered to the students; perhaps the discrete lessons delivered through video help alleviate issues with student motivation and boredom. The goal of education is to direct and guide all students to reach their optimal potential. The theory behind this study is that, with a positive attitude, an effective teaching technique, and the inclusion of a powerful technological resource, students can improve on math word problems.

Since word problems entail both reading and math material and Khan Academy is a successful mathematics instruction website, this study will explore whether the Khan Academy can still have as much success in the math field when reading is involved.

The overall goal to this study will be to explore how flipped instruction using technology might support students' success with word problems. Specific questions include the following:

- Does flipped instruction with Khan Academy work with word problems?

- How do attitudes towards technology affect the outcome of students' success?
- How do attitudes towards word problems affect the outcome of students' success?

Chapter 2: Literature Review

Khan Academy and Flipped Instruction

The Khan Academy is an increasingly popular website established by Salman Khan in 2006. The website consists of over 4,000 free mini video and audio based lectures across all grade levels including most topics in mathematics and science ("Khan Academy," 2013).

In the past few years, Khan Academy has been credited with making a positive impact on various schools and improving teaching methods, with supporters such as Google, Bill Gates, and Reed Hastings (Noer, 2012). Instead of lecturing to the students in the classroom and then sending them home with homework that they can apply their newly acquired knowledge to, teachers use Khan Academy to provide flipped instruction in math concepts. Students watch specific videos on their own time, at their own pace, and material can be repeated as many times as needed. At school, students are given work to apply what they have learned with the teacher's supervision and guidance. Promoters of this "disruptive technology" (Christensen et al., 2008) believe the mastery of discrete lessons helps build student confidence and skills, providing a groundbreaking approach to help today's struggling students. Not everyone agrees with the flipped instruction technique. "Critics argue that Khan's videos and software encourage uncreative, repetitive drilling—and leave kids staring at screens instead of interacting with real live teachers"(Thompson, 2011, p. 1). Others counter that; some students may need repetitive drilling and hearing the same thing over and over again in order to grasp a concept (Thompson, 2011). Both sides to the argument are fair, but it depends on the student's personal needs and preference for which one technique is considered better.

As of right now, a school in Los Altos, CA is incorporating the Khan Academy and flipped instruction into the curriculum because of the promise of the impact it might have on their students. When visited, a seventh grade math teacher presented the statistics gathered on the website from a student of hers. "A look at the data shows that the students seem to advance in spurts: A kid will grind away at a subject, seemingly stuck, until suddenly something clicks and he vaults forward, sometimes going on a tear and mastering several new subjects in a day or two" (Thompson, 2011, p. 4). She also explained that it was not just one student who has benefited from this process, but many. These data indicate that flipped instruction can yield positive results in terms of content mastery when properly executed.

Word Problems

Word problems are one of the most difficult concepts to master in schools for many students. When students are asked to complete simple math or "hard" math equations embedded within stories, students seem to have difficulty successfully completing the problems (NCES, 2012). Reading comprehension seems to be a major factor in why this occurs. If students cannot understand what they are reading, then they cannot properly determine what equation or technique to use in order to solve a mathematics word problem.

Jonassen (2003) has provided a conceptual explanation for the difficulty of word problems. There are at least three sets of information that the reader must gather in order to solve word problems including at least two sets of "reference" items and then one "combination" set. For the reference sets there are three pieces that the reader must find, (1) the specification, (2) the specification's objects involved, and (3) the quantity of the

specification's objects. The combination set is the information needed to combine the reference sets. This set entails the "specification" (the key word(s) that is used to determine how to mathematically combine each of the sets of "reference" information), the "objects" which the specification is looking to combine and then the final "quantity". Most of the information for each set is in word format, and a third of each "reference" set of information is in numerical form. A visual diagram of this can be seen below (Jonassen, 2003, p. 272):

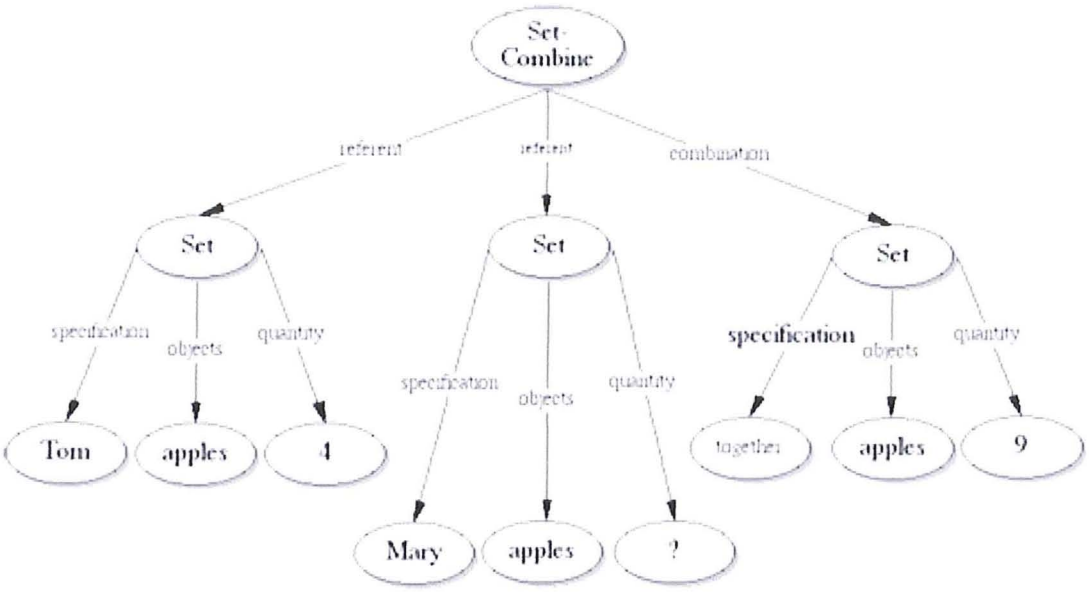

Fig. 1. Semantic network of combine story problem.

Figure 1: Semantic network of combine story problem.

During word problems, students are always looking for at least nine pieces of information in order to solve a basic problem. During a regular mathematic problem such as 4+5=__, students are looking for four pieces of information: the two "reference quantity" sets, the "combination specifications", and then the final "combination

quantity". Word problems are much more difficult for students because they are looking to gather and compute more than twice as much information in a single problem than in a linear function.

Word problems are normally solved by learners identifying key concepts and values in a short scenario, selecting the appropriate algorithm, applying the algorithm to generate a quantitative answer, and hopefully checking their responses (Jonassen, 2003; Sherrill, 1983).

During Jonassen's studies (Jonassen, 2003), he discovered that students must use a three-step strategy to figuring how to solve word problems. They must "search for key-words," "select an algorithm or formula based on key words," and then "apply the algorithm" to the problem (2003, p. 278). The most common mistake made in all word problems by students is that they do not follow one of those steps mentioned above, which most of the time leads to an incorrect answer. Jonassen stated in his conclusion that in order for students to properly and effectively solve word problems, they must know how to "classify problems and construct conceptual models of problems before using formulas for solving problems (2003, p. 294).

In a study conducted in 2005 by Deatline-Buchman, Jitendra, & Xin, two types of instruction for word problems for fifth grade special education students were compared. During this study the two groups were taught two different styles of solving math word problems, (1) "schema-based instruction" and (2) "general strategy instruction." Schema-based instruction included the following steps: (a) read to understand, (b) identify the problem type, (c) use a schema diagram to represent the problem, (d) transform the diagram to a math sentence, (e) solve the problem, and (f) look back to check. The

general strategy instruction was based on the following characteristics: (a) read to understand, (b) draw a picture to represent the problem, (c) solve the problem, (d) look back to check (Xin, Jitendra, & Deatline-Buchman, 2005). Students were then asked to complete the same word problem exam using the method of solving word problems that they were taught. The results showed that schema based instruction was more effective than general based instruction. "Schema-based instruction teaches conceptual understanding of problem structure, which facilitates higher-order thinking and generalizable problem solving skills. Although the "draw a picture" strategy in the general based instruction condition emphasized understanding of the problem, the representation step of the strategy focused more on the surface features of the problem and did not allow students to engage in the higher-level thinking necessary to promote generalizable problem-solving skills" (Xin et al., 2005, p. 190). What this means is that the more visual way is not always the best way to learn and solve a complex problem.

Student Learning and Technology

Technology elicits images of computers, electronics, productivity, and many other types of engineering marvels. Engaging sources like video can be very beneficial to students, young learners or even higher-level learners. When designed to foster higher-order thinking, technology use has the potential to transform learning (Jonassen, 2003). Further, students themselves are calling for a re-visioned schoolroom, where digital connections and technology-enhanced learning are part of their experiences (Project Tomorrow, 2011).

Although solid empirical research on the impact of technology is difficult to find in the K-12 environment, studies in higher education have shown that technology can

have documented positive impacts on some kind of learning, for example, vocabulary, conceptual knowledge, and reflective observation (Hui, Hu, Clark, Tam, & Milton, 2008). In addition, using technology in the classroom can increase student motivation for learning (Cheung & Slavin, 2013).

Just allowing students access to the same class content via video seems to be a support for student learning. In a recent study done at Loyola Marymount University in Los Angeles, CA, the investigator wanted to see whether or not classes equipped with video and audio recording technology that recorded each class session and was put readily available online would be helpful compared to a class without that access (Ford, Burns, Mitch, & Gomez, 2012). Students would be able to view the lesson an unlimited amount of times on their own time to help review past lessons and material. The study, conducted for two semesters in two different psychology classes, came back with some interesting results.

"The findings from this study provide some support for the effectiveness of Classroom Capture Technology as a supplement in an undergraduate lecture-based course. These findings suggest that the use of Classroom Capture Technology as a pedagogical tool is associated with significant increases in time spent studying and increased student perceptions that a course challenged them to do their best work" (Ford et al., 2012, p. 191).

Similarly, in a recent study in four schools in Australia, school officials installed web-based lecture technology for four teachers to use at their leisure for their classes for a semester. These tools provided visual and audio-based recordings of a lecture. Students had access to these lectures from an online database 24 hours a day, 7 days a week.

"There were variations in the way the different medias were used within and across universities, ranging from audio-only, to audio accompanied by Power-Point slides, to full video. Delivery methods to students included: streaming, downloading to computers or mobile devices, and podcasting" (Gosper et al., 2011, p. 87). Despite the variations across classrooms, the results came back conclusive on a variety of scales.

Students were asked if technologies made learning easier; 79.9% said that it helped significantly, 13.4% said it moderately helped, and 6.7% said it didn't help. When asked if the Web-based Lecture Technology helped the learning the process, 66.7% of the students said that it helped significantly, 23.3% said that it moderately helped, and only 9.9% said that it didn't help them (Gosper et al., 2011).

When the faculty of the schools were asked whether the web-based lecture technologies helped make the learning process easier, 48.9% said that it did help, 38.1% weren't sure, and 13% said that it didn't help (Gosper et al., 2011).

Finally, when both the students and faculty were asked whether web-based lecture technology helped achieve better results, the results came back slightly different. About 67.7% of the students said that it helped, but only 30.2% of the faculty said that it helped. Out of the student population only 23.3% said that they weren't sure if it helped them or not, while the staff population reported 54.7% of them saying the same thing. Only 9.9% of the students said that it didn't help, while 15.2% of the faculty said that it did not (Gosper et al., 2011).

According to this study, the whole nature of teaching or lecturing in the classroom may not actually be that essential for class time. If students were given the opportunity to primarily watch their class lectures at home for homework, teachers might have more

time to work directly with students on applying their newly acquired knowledge to real-life situations.

Another important study directly compared online lecture-based learning to in-class problem-based learning to explore which might bring better results. The study consisted of 97 students who accessed online materials in place of traditional lectures over a total of six lessons. That information was re-enforced via in-class active learning. The last six lectures were traditional and in the classroom (Lancaster, McQueeney, & Amburgh, 2010). The online lectures consisted of PowerPoint presentations, diagrams, audio and visual enhancements, and other files. These lectures were available 24 hours a day, 7 days a week and were able to be viewed by anyone an unlimited amount of times. Students were then given quizzes to finish before and after each lecture, including the online and traditional in class lectures. The results came back to show that the online lecture-based learning with in-class active learning was more effective than the traditional in-class lecturing. Students performed better on quizzes and exams by learning the material on their own time through self-study and supplementary in-class activities compared to traditional class-time with subject lectures on the same material.

All of these studies about the efficacy of online content transmission speak to the potential of the Khan Academy approach to instruction, where students have access to the content via an online platform and are able to review that content at their leisure.

Chapter 3: Methods

Introduction

In order to explore whether or not flipped instruction in a classroom might have an impact on reading, this study used a Khan Academy mathematics lesson on math word problems. In "flipped instruction," students get the "how to" portion for homework through some video or other outside-of-class experience and then come back and apply their knowledge at school in the classroom rather than teachers presenting the "how to" portion of a unit. The pedagogical rationale is that the teacher in the classroom can both help anyone who is having trouble with applying concepts using a one-on-one basis and can support the class in applying the lesson in practical matters and/or in constructivist ways (Bergmann & Sams, 2012).

Human Subjects

The project sought and received approval from the Wagner College Human Experimentation Review Board (HERB). The approval assured adherence to human subjects guidelines and code of ethics throughout the study. (See Appendix I.)

Because this study took place in the public school system, New York City Department of Education (NYC DOE) approval was also necessary. The study also agreed to adhere to NYC DOE specific guidelines. (See Appendix II.)

Participants

The classes of participants for this study were selected randomly from a group of teachers in the school who were willing to participate in the study. The participants consisted of 50 fifth grade students and two mathematics teachers with Master's degrees in teaching. The two teachers were very supportive towards the study and were willing to take time out of their busy days to help out. Both teachers were fully aware of what the study was trying to possibly find and they knew the complete agenda and schedule for every day's activities. The students of the classrooms were only informed about what needed to be done for each activity and were not informed of any future activities that would come. The students, the students' parents, and teachers were informed of the potential risks and benefits of the study through an informed consent process. (See Appendices IV & V.)

Progression of Study Activities

The study took roughly 3 weeks. The first week consisted of the researcher coming in and meeting with each of the cooperating teachers for approximately 3-4 hours throughout the week during the teachers' free periods so that they could learn about the study and ask any questions they might have had. Both teachers consented to participate in the study. (See Appendix V.) Students received consent forms to the students to get signed by parents and returned two days later. The student consent forms were almost exactly like the teacher consent forms except that they were directed towards the parents to sign since all of the prospective subjects were under the age of 18. If students did not return a consent form, then they were not actually allowed to participate in the study at all

and any information that was distributed to them was not used or collected for analysis. Students were also given the opportunity to assent to participation. All students with consent forms assented.

Once all of the consent forms came back, students received Questionnaire #1. (See Appendix VIII.) This survey asked the students about their experience with word problems and their attitudes towards word problems and technology in general. This form only took 15-20 minutes to complete. The next day, teachers were asked to teach a lesson on word problems, as they normally would do, which took approximately 40 minutes. Afterwards, the cooperating teachers handed out Assignment #1 for homework to be returned the next day and graded by the researcher. (See Appendix VI.) Once again, only those who had their student/parent consent form signed and returned had Assignment #1 submitted to the study. The next day, the cooperating teachers showed the students the Khan Academy site in the context of another lesson that did not include word problems. The lesson that the cooperating teachers chose was a lesson on interior angles of a triangle. This lesson also took up roughly 40 minutes of class time. Then finally, on the next school day, with no re-teaching of word problems, students were given a similar assignment to Assignment #1 (Assignment #2), including an expressed task to view a particular Khan Academy video that addressed the content behind the word problem homework (*Word Problem Solving Plan 1*, 2010). In order to ensure all students had access to the website, students did this assignment in the classroom while using laptops that the school provided. Once the students finished their assignment it was taken, graded, and compared for analysis.

On the last and final day, students were given Questionnaire #2 to fill out. All data were collected from willing participants and then compared with post questionnaires and assignments.

Figure 2: Timeline of Progression of Study Activities

Monday (Week #1)	- Discussed study with cooperating teachers.
Tuesday (Week #1)	- Discussed study with cooperating teachers.
Wednesday (Week #1)	- Discussed study with cooperating teachers.
Thursday (Week #1)	- Distributed teacher consent forms and had signed.
Friday (Week #1)	- Distributed student consent forms for parents to sign and return.
Saturday (Week #1)	No School
Sunday (Week #1)	No School
Monday (Week #2)	- Students returned with signed student consent forms.
Tuesday (Week #2)	- Distributed Questionnaire #1 for students to complete and hand back in.
Wednesday (Week #2)	- Teachers taught a lesson on word problems as they normally would. - Teachers then distributed Assignment #1 for homework.
Thursday (Week #2)	- Teachers introduced Khan Academy website through a non-word problem based lesson.
Friday (Week #2)	- Teachers distributed Assignment #2 where students watched a Khan Academy Word Problem lesson and completed word problem questions.
Saturday (Week #2)	No School
Sunday (Week #2)	No School
Monday (Week #3)	- Students were given Questionnaire #2 to fill out and complete.

Instrumentation

Introduction

The main goal for this study was to see whether or not there would be improvement in students' performance on word problems after the use of flipped instruction and technology. Because performance on word problems could differ by student characteristics, the study collected data on students' affect towards math word problems and technology.

Questionnaires #1 & #2

The questionnaires were primarily designed to assess students' attitudes towards math both before and after the assignments. The study queried what students' favorite subjects were, asking students to rank seven major academic subjects from their favorite to least favorite. The seven subjects were science, social studies, math, English language arts, gym, art, and music. The plan was to tally up each subject to see which subject was the overall favorite and which was the least favorite.

Another key focus question explored students' opinions about how good they thought they were with word problem both before and after using the Khan Academy website. This question was answered on a number scale from 1 to 10, where 1 was "Really Bad," 10 was "Super Great," and 5 was "Okay." If the students marked a higher number on the 2nd Questionnaire than the 1st Questionnaire, it might indicate that the students were either more confident with solving word problems after Khan Academy instruction and/or they enjoyed the Khan Academy flipped instruction method of teaching. If students marked a lower number on the 2nd Questionnaire than the 1st Questionnaire, it might indicate that they were either confused or did not like the Khan

Academy flipped instruction method and/or their confidence for word problems diminished.

Assignments #1 & #2

The data for the two assignments were analyzed the same way. Each assignment consisted of 4 word problem questions that were similar in content and wording. Each question was worth 25 points, 15 for answers and 10 for showing work. Partial credit was given depending on whether sufficient work was shown. If some work was shown, students received 5 points, but if they showed all work then they received 10 points; they received no points if they showed no. If they answered the question correctly, regardless of whether they showed work or not, they received 15 points. Only the four word problems were graded and included in the analysis and comparison of the pre- and post-data.

In order to explore changes in scores between assignments scores were calculated as follows: Let "S1" represent the score of a single student's Assignment #1, and "S2" represent the score that student's Assignment #2. By using the formula: (S2 – S1), if the score was greater than 0, the recipient received a mark of 1; if the score was less than 0 the recipient received a mark of -1; and if the recipient received a score of exactly 0, the recipient received a mark of 0. Once all of the marks were calculated, the marks were added up to get a total number, which was then divided by the total number of mark tallies to get an average number. This number was then used to represent the result. Since the total number of students in this study was 50, any number greater than 5.0 or less than -5.0 would be considered a large effect.

Additionally, using a two-tailed T-test, the study explored changes in each of the four question types to assess whether pattern across questions were consistent. This process helped guard against irregularities that might have influenced score change patterns.

Chapter 4: Analysis

Data for Questionnaires #1 and #2 are presented separately, with comparisons between similar items discussed in the Questionnaire 2 section. Data for the pre-post assignments are presented simultaneously, with implications discussed also in Chapter 5. See Appendices VI, VII, VIII, and IX for data collection instruments.

Questionnaire #1

After distributing Questionnaire #1 to the students to gather their initial feelings, opportunity to do math word problems, and self-efficacy regarding math word problems and other related topics to the study, the results came back as follows.

Background Questions

The first question on Questionnaire #1 asked the students whether they had completed a math word problem before. The results showed that every student said that they had done a math word problem before. Math word problems were not something new to any of the students being studied. (See Table 1.)

Table 1: Familiarity with Math Word Problems

Have you ever done a math word problem before?		
	Yes	No
Number of Students	**50**	**0**
% of Students	**100%**	**0%**

When students were asked if they owned a computer, tablet, cell phone, or any device that could connect to the Internet at home, all but one student said that they did; 49 out 50 students said that they had a device at home that could connect to the Internet (See Table 2.)

Table 2: Use of Internet Devices

Do you own a computer, tablet, cell phone, or any device that can connect to the Internet at your home?		
	Yes	No
Number of Students	**49**	**1**
% of Students	**98%**	**2%**

Students were asked to rank order their academic subjects from most to least favorite. The subjects that they were given as choices to list were Science, Social Studies, Math, English Language Arts, Gym, Art, and Music. Calculating the frequency for the total responses to each of the 7 listed columns produced lists that showed which subject was heavily favored and disfavored throughout the two classes. From most favorite to least favorite, the overall consensus showed that Math was their favorite subject while Social Studies was their least favorite. The complete order from favorite to least favorite was Math, Gym, Music, English Language Arts, Art, Science, and then Social Studies. Table 3 shows the ranking from most to least favorite and least to most favorite using frequency of rankings. For instance, 22 of the students chose Math as their most favorite subject and 18 students chose Social Studies as their least favorite subject.

Table 3: Favorite and Least Favorite Subjects

Number Choosing a Subject as Favorite	Number Choosing a Subject as Least Favorite
Math (22)	Social Studies (18)
Gym (12)	Science (10)
Art (5)	Music (9)
Music (4)	ELA (6)
ELA (3)	Art (5)
Science (2)	Math (2)
Social Studies (2)	Gym (0)

Students were asked if they enjoyed using technology in the classroom or not. Forty-eight students said that they enjoy using technology in the classroom; two said that they did not. (See Table 4.)

Table 4: Classroom Technology Enjoyment

Do you enjoy using technology in the classroom?		
	Yes	No
Number of Students	**48**	**2**
% of Students	**96%**	**4%**

When asked whether they ever used Internet sources at home to help with math homework, 64% of the students said that they had used the Internet for help on math homework and 36% said that they had not used the Internet for help on math homework. (See Table 5.)

Table 5: Internet Help on Math Homework

Have you ever used the Internet at home for help on math homework?		
	Yes	No
Number of Students	**32**	**18**
% of Students	**64%**	**36%**

Associations with word problems

Students were asked to write down 3 words that came to mind when they thought about word problems. Out of the 150 words given, the top 6 words that were most frequently written down as responses were Divide, Multiply, Operations, Addition, Subtract, and Numbers. A full list of the words in alphabetical order can be seen in Appendix X. Table 6 provides a frequency chart of the top 6 words that were mentioned by students in the questionnaire.

Table 6: Word Problem Word Associations #1

When you think of word problems, what three words come to mind?						
	1	2	3	4	5	6
Word	**Divide**	**Multiply**	**Operations**	**Addition**	**Subtract**	**Numbers**
Number of students who wrote words	**10**	**10**	**8**	**7**	**6**	**6**
% of Students who wrote words	**20%**	**20%**	**16%**	**14%**	**12%**	**12%**

Word problem confidence

Question #3 in Questionnaire #1 asked students how good they felt they were at math word problems on a scale of 1 to 10, where "1" was considered "Really Bad" and "10" was considered "Super Great." The average score came out to be 7.16. Twenty-two percent of the students deemed themselves to be below average, while 28% of the students described themselves as above average, and 50% of the students saw themselves as beyond just above average. Table 7 shows the distribution of how many students chose what answer. In order to see patterns more clearly, student responses across the 10 categories were aggregated into 4 categories. The top three (8,9, and 10) and bottom three (1,2, and 3) each formed their own categories; the middle section formed 2 separate categories: bottom middle (4 and 5) and top middle (6 and 7). Half of the class was in the top 3 category while the other half was split fairly evenly into the top and bottom middle categories. No students ranked themselves in the bottom category.

Table 7: Math Word Problem Confidence #1

How good are you at math word problems?										
Groups	Bottom			Bottom Middle		Top Middle		Top		
	1	2	3	4	5	6	7	8	9	10
Number of Students	**0**	**0**	**0**	**0**	**11**	**8**	**6**	**13**	**11**	**1**
% of Students	**0%**	**0%**	**0%**	**0%**	**22%**	**16%**	**12%**	**26%**	**22%**	**2%**
% of Students	**0%**			**22%**		**28%**		**50%**		

Questionnaire #2

Questionnaire #2 was handed out to the students to complete after the completion on Assignment #2.

Associations with word problems

In Questionnaire #2 the question was asked: "When you think of word problems, what 3 words come to mind?" The 6 words that were most frequently written were: operations, multiply, numbers, how much/many, divide, and addition. (See Table 8.)

Table 8: Word Problem Word Associations #2

When you think of word problems, what three words come to mind?						
	1	2	3	4	5	6
Word	**Operations**	**Multiply**	**Numbers**	**How much/many**	**Divide**	**Addition**
Number of students who wrote word.	**12**	**11**	**9**	**8**	**7**	**7**
% of Students who wrote word.	**24%**	**22%**	**18%**	**16%**	**14%**	**14%**

As Table 8 shows, most of the words mentioned in Questionnaire #1 were also mentioned in Questionnaire #2 as top 6 words. However, words like "operations," "how much/many," and "numbers" went up in frequency after the students were introduced to the word problem assignments. "Operations" went up 8% in frequency, "how much/many" went up 10% in frequency, and "numbers" went up 6% in frequency. Since the word problem assignments were introduced prior to the second questionnaire, a possible reason for why the words "how much/many" made such a jump in the rankings could be because the words "how much/many" were mentioned twice in each assignment.

Word problem confidence

On both Questionnaire #1 and Questionnaire #2 the question: "How good are you at word problems?" was asked. Students circled a number between 1 and 10 that they felt

described their overall ability to successfully complete a word problem. The scale was described as 1 being "Really Bad," 5 being "Okay," and 10 being "Super Great." This question was asked in order to determine the confidence of students both before and after the assignments.

On the first questionnaire, which was distributed before any other assignment in the study, students scored themselves, on average, a 7.16 on word problem ability.

On the second questionnaire, which was completed at the end of the study, the same 50 students rated themselves very similarly to Questionnaire #1's results. Their average score was a 6.97. Even though there was a drop of 0.16 in the average score from Questionnaire #1, the number is close enough to say that there was relatively no change.

Table 9: Math Word Problem Confidence #2

How good are you at math word problems?										
Groups	Bottom			Bottom Middle		Top Middle		Top		
	1	2	3	4	5	6	7	8	9	10
Number of Students	**0**	**0**	**0**	**2**	**12**	**6**	**12**	**7**	**8**	**3**
% of Students	**0%**	**0%**	**0%**	**4%**	**24%**	**12%**	**24%**	**14%**	**16%**	**6%**
% of Students (Groups)	**0%**			**28%**		**36%**		**36%**		

Student assessments of Khan Academy

In Questionnaire #2, students were asked a series of questions about their experience with the Khan Academy lessons.

The first question on Questionnaire #2 asked the students simply if they were able

to access and use the Khan Academy website. All 50 students responded with a unanimous yes. (See Table 10.)

Table 10: Khan Academy Website Accessibility

Were you able to use the Khan Academy website?		
	Yes	No
Number of Students	**50**	**0**
% of Students	**100%**	**0%**

The students were then asked how many times they watched the specific word problem video from the Khan Academy website. The students were able to watch the video as many times as they pleased from wherever they did their homework. Most of the students (39) watched the video two times, while six of the students only watched it once and the remaining five students watched it three times or more. Table 11 shows the results on how many students watched the video a certain number of times.

Table 11: Amount of Times Students Viewed Word Problem Video

If you used the Khan Academy website, how many times did you watch the word problem video for help?						
	0	1	2	3	4	5+
Number of Students	**0**	**6**	**39**	**3**	**1**	**1**
% of Students	**0%**	**12%**	**78%**	**6%**	**2%**	**2%**

The students were then asked their opinions about Khan Academy. Students were

asked to rate whether Khan Academy was helpful to them or not, using a scale from 1 to 10, where 10 was very helpful and 1 was not helpful. (See Table 12.)

Table 12: Student Opinions on Khan Academy Website

On a scale of 1 to 10, where 1 is not helpful and 10 is very helpful, please rate how much Khan Academy helped you:										
	1	2	3	4	5	6	7	8	9	10
Number of Students	**1**	**2**	**5**	**11**	**10**	**5**	**5**	**5**	**4**	**2**
% of Students	**2%**	**4%**	**10%**	**22%**	**20%**	**10%**	**10%**	**10%**	**8%**	**4%**

On the final question of Questionnaire #2 about the assessment of the Khan Academy, the students were asked if they would ever use the Khan Academy site again. They were given the choices "yes," "no," or "maybe." The majority of the students (34 students) were uncertain whether they would use it again, while 14 students said that they would use it again and 2 students said that they would not. (See Table 13.)

Table 13: Future of Khan Academy Use By Students

Will you use the Khan Academy website for future lessons that you find difficult or that you don't fully understand?			
	Yes	No	Maybe
Number of Students	**14**	**2**	**34**
% of Students	**28%**	**4%**	**68%**

Questionnaire #1 & #2 vs. Assignment #1 & #2

Analyses of questionnaires and assignments explored why students had trouble with certain questions or the whole assignment and whether or not their attitude had a part to play on their success or lack of it on the assignments.

Questionnaire #1 showed that all of the students had done a word problem before, all of them owned an "Internet ready device" such as a computer or tablet at home, and all of them enjoyed using technology in the classroom. This information helped rule out the influence of contextual factors in the actual performance on the assignments. To gauge whether attitudes played a role in performance, students' favorite and least favorite subjects were examined, and math was said to be the favorite subject among the participants, helping establish that the learning context around mathematics was positively viewed. Students also generally felt confident about their skill with word problems, rating themselves on a scale from 1 to 10 as 7.13. The pre-assessment on contextual and attitudinal factors did not appear to be negative predictors for performance on Assignment #1.

Interestingly, students' opinions about their own skill with math word problems decreased over the study. The first time they answered the question, the class average was a 7.13 and their performance on the actual word problems was 50.4%. For the second assignment, however, students dropped their assessments of their skill levels to 6.97 on average, despite performing at a higher 56.7% on the actual word problems.

Whether students had previously used the Internet at home for math homework showed on association with scores on the assignments. When asked the question "Have you ever used the Internet at home for help on math homework?" 62% of the students

said that they had before and 38% said that they had not. Students who said they had used the Internet at home scored higher on both the first and the second assignments compared to students who had not used the Internet at home. Students who said yes received an average score of 53.54% on Assignment #1 and 57.74% on Assignment #2, while students who said no received an average score of 50.00% on Assignment #1 and 55.00% on Assignment #2. The overall scores for these assignments were 50.40% for Assignment #1 and 56.7% for Assignment #2. (See Table 14.) Importantly, however, both student groups increased their average scores by nearly the same amount, indicating that prior Internet use for math help is not a determining factor for students' benefitting from flipped instruction.

Table 14: Comparison of Assignments and Internet Help at Home

	Assignment #1	*Assignment #2*
Average Overall Score *n= number of total students*	**50.40%**	**56.70%**
	n=50	**n=50**
Students who answered "Yes" (Difference from average overall score) *n= number of students who said "Yes"*	**53.54%** **(+3.14%)**	**57.74%** **(+1.04%)**
	n=32	**n=32**
Students who answered "No" (Difference from average overall score) *n= number of students who said "No"*	**50.00%** **(-0.40%)**	**55.00%** **(-1.70%)**
	n=18	**n=18**

Assignment #1 vs. Assignment #2

Table 15 displays the average score for each question and the overall final average score for each assignment. Fifty students were graded on both assignments.

Table 15: Assignment #1 & Assignment #2 Average Scores by Question Number

Assignment #1						Assignment #2				
#1.1	#1.2	#1.3	#1.4	Grade%		#2.1	#2.2	#2.3	#2.4	Grade%
15.1	9.2	16.8	9.3	50.40%		10	16.1	18.1	12.5	56.70%
						-5.10%	5.90%	1.30%	3.20%	6.30%

Results show a 6.3% improvement between Assignment #1 and Assignment #2 across all questions.

Analysis of Changes in Pre-Post Assignments

The lack of symmetry across question improvements invited further analysis. Data were brought into SPSS Statistical software to explore whether changes across items represented significant patterns that would not have resulted by chance. By doing a paired sample test, results provided an analysis of significance and lack of significance in the comparison between each of the corresponding related questions. Scores for the first paired question were lower on the second assignment. On all other questions, scores were higher on the second assignment.

Table 16: Paired Samples Test- Comparison Between Assignment #1 & Assignment #2

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 1.1 - 1.2	5.1	9.3	1.3	2.4	7.7	3.9	49	.000
Pair 2 2.1 - 2.2	-6.9	8.8	1.2	-9.4	-4.4	-5.5	49	.000
Pair 3 3.1 - 3.2	-1.3	11.7	1.6	-4.6	2.0	-.8	49	.437
Pair 4 4.1 - 4.2	-3.2	10.5	1.5	-6.2	-0.2	-2.1	49	.037

Results showed that there was only one question pair, Pair 3, which did not show significant differences. The rest of the question pairs were considered significant since their p-values were below .05.

Chapter 5: Implications/Conclusions

Discussion of the Results

Students' confidence levels in mathematics were hypothesized to be a potential key factor in the students' success. However, study data provided no direct evidence of positive or negative impact of students' confidence levels on performance. Given students' high ranking of mathematics as a favorite subject, it is possible that the cooperating teachers created a positive mathematics environment that mitigated students' own potential math anxiety.

The design of the questions proved less precise than would be ideal for clear interpretations of the findings. The statistical analysis of each math question's change comparing traditional and flipped instruction performance showed inconsistent patterns. Detailed content analysis of the questions indicated that all questions were not comparably designed and/or might have had confounding variables influence the outcomes. For example, the first question pair (1.1 & 2.1) that showed a decline in the overall average had to do with finding a percentage discount on the sale of a product. Both questions were worded almost identically, but the numbers were changed. One possible reason for the abnormal pattern compared to other questions could be because of the way the teacher taught a lesson on how to find percentages. Before the first assignment (Assignment #1) the teacher taught both classes how to solve percentage math problems in a way that was different from the Khan Academy video students used for Assignment #2. The Khan Academy method may have confused the students, which could possibly explain the 5.1% drop in overall scores for the first question. If this were so, it would be interesting to see how the students would have performed to a teacher-

created video rather than Khan's.

On the second question set (1.2 & 2.2), students improved drastically on their assignment scores. Further analysis of the question set revealed that the amount of work needed to find the answer. For the first question, question 1.2, which was on the first assignment, the correct answer was a number that ended in a remainder. Students had to do more work to find the extra decimal place numbers in that question. The comparable question on the 2nd assignment, question #2.2, seemed to be easier due to the correct result being a round number that did not include any remainders.

The third set of questions did not demonstrate statistically significant improvement, but students did improve after viewing Khan Academy. For this particular question the Khan Academy instruction may have been beneficial. The items were comparable in difficulty. While not statistically significant, given the positive direction of the performance and the small sample size, this question indicates possible positive impacts of the flipped instructional approach.

Question set #4 may also have been slightly skewed. There was a 3.2% increase in test results for this question on interior angles. It happens that the teacher's first lesson, a non-word problem lesson introduction that used the Khan Academy website, was an interior angle topic. The teacher used a Khan Academy video lesson on the interior angles of a triangle, which was the content of question #4 on both assignments. Seeing the Khan Academy method on how to solve for a missing angle in a triangle twice from the Khan Academy website could have prompted even stronger positive results for solving the problem.

Although data were inconclusive in terms of consistent patterns, the study indicates

Khan Academy may be a helpful tool for supporting student's work with word problems. Khan Academy is increasingly thought to be a helpful math and science related website for students of all ages (Khan, 2013). To the extent that math word problems require strong reading, this study finds that Khan Academy could be useful for reading and vocabulary as well. Students were given two different assignments that incorporated the same general language of questions asked; the only thing that was different about the questions in the assignments were the numbers that needed to be calculated by the students and the instruction before each assignment. The first assignment entailed the standard approaches to teaching a lesson and the second way entailed flipped instruction using Khan Academy. The students were able to improve by 6.3% on the flipped instruction assignment compared to the first assignment that did not incorporate flipped instruction. Although there may have been some improvement because students had recently done word problems, it is also very possible that flipped instruction helped them process the word problems in ways that supported reading for the complex requirements word problems entail (Jonassen, 2003).

With the assignment scores showing improvement due to the Khan Academy use, this could merit possible explorations of more extensive uses of flipped instruction to help students master skills. The implications showed that flipped instruction from Khan Academy might be more successful than the traditional lecturing from teachers.

Limitations of the Study

Since the participant size in this study was small, any generalizations about the findings are not merited. However, the data from the study did show positive impacts,

indicating that further studies like this one would be worthwhile.

Overall, the data were straightforward to collect and analyze. However, for the researcher in the classroom, it seemed students were discouraged and frustrated due to the overwhelming amount and difficulty of material they were covering. For most questions, students had trouble finding answers; some students even seemed to give up before finishing. Perhaps if the student participants were 6th or 7th graders, the assignments wouldn't have been as overwhelming for them and different response patterns might have emerged. Alternatively, if the assignments had been easier, maybe their frustrations would have been more limited and response patterns might have been different.

Even so, students were cooperative during the study, as were cooperating teachers. The study design seems appropriate for classrooms and is easy to implement. It would be worthwhile for similar studies to explore how students might benefit from Khan Academy or other flipped instruction.

Conclusion

To conclude this study, in order for flipped instruction and word problems to be considered conclusively beneficial to students, more studies of this sort must be conducted. This study only proved that there may be some evidence that implies that word problems together with flipped instruction could be beneficial to a student's success in the classroom.

Resources

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Appendix

Appendix I: HERB Approval Letter

---------- Forwarded message ----------
From: **Steve Jenkins** <steven.jenkins@wagner.edu>
Date: Mon, Mar 11, 2013 at 3:08 PM
Subject: HERB Proposal F12-13
To: Karen DeMoss <karen.demoss@wagner.edu>

Dear Mr. Doxey and Dr. DeMoss:

Your revised research proposal entitled "In What Way Might Flipped Instruction Using Technology Support Students' Success with Word Problems" (HERB project #F12-13) is approved by the Human Experimentation Review Board (HERB) under the "no harm" review on contingent upon the changes incorporated to the documents attached to the previous email.

Upon revision, this project complies with all of the requirements of HERB for the protection of human participants in research. Unless renewed, approval lapses one year after the approval date.

1. A project status report (available on the HERB website) must be returned to HERB within one year.

2. Any significant change in the experimental procedure must be reported to HERB immediately prior to altering the project.

3. Any injury to a participant because of the research procedure must be reported to HERB immediately.

4. The investigator must keep all signed consent forms on file for 3 years past completion of the project.

5. HERB must be informed of the addition of new investigators not named in the original application.

Please inform HERB when the study has been completed. All future correspondence regarding this project should display the HERB identifying number.

Best wishes,

Steve M. Jenkins, Ph.D.

Acting Chair, Human Experimentation Review Board

Appendix II: IRB Approval Letter

NYC
Department of Education
Dennis M. Walcott, Chancellor

Research and Policy Support Group

52 Chambers Street
Room 309
New York, NY 10007

1 212 374-7659 tel
1 212 374-5908 fax

April 2, 2013

Mr. Brian R Doxey
9 Sutton Court
West Islip, NY 11795

Dear Mr. Doxey:

I am happy to inform you that the New York City Department of Education Institutional Review Board (NYCDOE IRB) has approved your research proposal, "In what ways might flipped instruction using technology support students' success with word problems?." The NYCDOE IRB has assigned your study the file number of 363. Please make certain that all correspondence regarding this project references this number. The IRB has determined that the study poses minimal risk to participants. The approval is for a period of one year:

Approval Date: **April 2, 2013**
Expiration Date: **April 1, 2014**

Responsibilities of Principal Investigators: Please find below a list of responsibilities of Principal Investigators who have DOE IRB approval to conduct research in New York City public schools.

- Approval by this office does not guarantee access to any particular school, individual or data. You are responsible for making appropriate contacts and getting the required permissions and consents before initiating the study.
- When requesting permission to conduct research, submit a letter to the school principal summarizing your research design and methodology along with this IRB Approval letter. Each principal agreeing to participate must sign the enclosed Approval to Conduct Research in Schools/Districts form. *A completed and signed form for every school included in your research must be emailed to* IRB@schools.nyc.gov . Principals may also ask you to show them the receipt issued by the NYC Department of Education at the time of your fingerprinting.
- You are responsible for ensuring that all researchers on your team conducting research in NYC public schools are fingerprinted by the NYC Department of Education. Please note: This rule applies to all research in schools conducted with students and/or staff. See the attached fingerprinting materials. For additional information click here. Fingerprinting staff will ask you for your identification and social security number and for your DOE IRB approval letter. You must be fingerprinted during the school year in which the letter is issued. Researchers who join the study team after the inception of the research must also be fingerprinted. Please provide a list of their names and social security numbers to the NYC Department of Education Research and Policy Support Group for tracking their eligibility and security clearance. The cost of fingerprinting is $115. *A copy of the fingerprinting receipt must be emailed to* IRB@schools.nyc.gov .

- You are responsible for ensuring that the research is conducted in accordance with your research proposal as approved by the DOE IRB and for the actions of all co-investigators and research staff involved with the research.
- You are responsible for informing all participants (e.g., administrators, teachers, parents, and students) that their participation is strictly voluntary and that there are no consequences for non-participation or withdrawal at any time during the study.
- Researchers must: use the consent forms approved by the DOE IRB; provide all research subjects with copies of their signed forms; maintain signed forms in a secure place for a period of at least three years after study completion; and destroy the forms in accordance with the data disposal plan approved by the IRB.

Mandatory Reporting to the IRB: The principal investigator must report to the Research and Policy Support Group, within five business days, any serious problem, adverse effect, or outcome that occurs with frequency or degree of severity greater than that anticipated. In addition, the principal investigator must report any event or series of events that prompt the temporary or permanent suspension of a research project involving human subjects or any deviations from the approved protocol.

Amendments/Modifications: All amendments/modification of protocols involving human subjects must have prior IRB approval, except those involving the prevention of immediate harm to a subject, which must be reported within 24 hours to the NYC Department of Education IRB.

Continuation of your research: It is your responsibility to insure that an application for continuing review approval is submitted six weeks before the expiration date noted above. If you do not receive approval before the expiration date, all study activities must stop until you receive a new approval letter.

Research findings: We require a copy of the report of findings from the research. Interim reports may also be requested for multi-year studies. Your report should not include identification of the superintendency, district, any school, student, or staff member. Please send an electronic copy of the final report to: irb@schools.nyc.gov.

If you have any questions, please contact Dr. Mary Mattis at 212.374.3913.

Good luck with your research.

Sincerely,

Mary C. Mattis, PhD
Chair, Institutional Review Board

cc: Barbara Dworkowitz

Letter to Principal

Appendix III: Letter to Principal

Dear Cooperating Principal,

I am a student with the Wagner College Education Department looking at your school and students to help conduct a study as part of my Master's degree in Childhood Literacy. I am interested in exploring whether an online resource is effective in helping students solve problems. During this study I will ask the cooperating teacher to incorporate a lesson on word problems into their curriculum and to incorporate an online resource in another lesson. Students will be asked to complete a pre- and post-questionnaire and to complete two short homework assignments on word problems. Students' names or any other personal information that may be collected will not be distributed or seen by any outside sources or publications. Identification will only be used solely for grading purposes. On one of the assignments, the students may need to use an "internet ready" device at home. If one is not readily available, it is not a problem, but if one is available please allow the student(s) to use it for educational purposes, perhaps during an after school program. This study should not take any more than 2 hours and might support students' success with word problems. If at any time you would like to stop a student's or class's participation in the study, you may, with no effects on you or students. Any information from the class would then be destroyed. You also can ask for results of the study and, if you would like, can come to the presentation of the results this spring at Wagner College's thesis symposium.

My hope is that we will learn how to better help students succeed in math word problems. If you have any questions about the study, please contact me (brian.doxey@wagner.edu, 631-835-0221) or Karen DeMoss (Karen.demoss@wagner.edu, 718-420-4070).

Parent Consent Form for Student Participation

Appendix IV: Parent Consent Form for Student Participation

Dear Parents,

My name is Brian Doxey, and I am excited to invite you to allow your child to participate in a study I am conducting as part of my Master's degree program in the Wagner College Education Department. I am interested in exploring whether an online resource is effective in helping students solve word problems. During this study, students will be asked to complete a pre- and post-questionnaire (Should take 10 minutes each) and to complete two short homework assignments on word problems (Should take up to a half hour for each). Data from these assignments will only be taken from those who agree to participate. The students' names or any other personal information that may be collected will not be distributed or seen by any outside sources or publications. Identification will only be used solely for grading purposes. On one of the assignments, the students may need to use an "internet ready" device at home. If one is not readily available, it is not a problem, but if one is available please allow your child to use it for educational purposes. This study should not take any more than 3 hours of free class time and 2 hours at home. If at any time you would like to stop your child's participation in the study, you may, with no effects on the student. Any information about your child will then be destroyed. You also can ask for results of the study and, if you would like, can come to the presentation of the results this spring at Wagner College's thesis symposium.

My hope is that we will learn how to better help students succeed in math word problems. If you have any questions about the study, please contact me (brian.doxey@wagner.edu, 631-835-0221) or Karen DeMoss (Karen.demoss@wagner.edu, 718-420-4070).

I, (Print Parent/ legal guardian's name)_____, give permission for my child, (Print Child's Name)_____, to take place in this study.

Parent's Signature:_____ Date:_____

Teacher Agreement Form

Appendix V: Teacher Agreement Form

Dear Cooperating Teacher,

By signing at the bottom you will be agreeing to help with a study administered by the Wagner College Education Department as part of my Master's degree in Childhood Literacy. I am interested in exploring whether an online resource is effective in helping students solve problems. During this study I will ask you to incorporate a lesson on word problems into your curriculum and to incorporate an online resource in another lesson. Students will be asked to complete a pre- and post-questionnaire and to complete two short homework assignments on word problems. I am providing copies of the work and questionnaires here.

Students' names or any other personal information that may be collected will not be distributed or seen by any outside sources or publications. Identification will only be used solely for grading purposes. On one of the assignments, the students may need to use an "internet ready" device at home. If one is not readily available, it is not a problem, but if one is available please allow your students to use it for educational purposes, perhaps during an after school program that allows students access to an "internet ready device", if such an after school program exists. This study should not take any more than a total of 3 hours of class time spread out through a 3 week period and might support students' success with word problems. If at any time you would like to stop your child's participation in the study, you may, with no effects on you or students. The names of students would be kept in the strictest confidentiality, and no identifying information would be presented in the study. You also can ask for results of the study and, if you would like, can come to the presentation of the results this spring at Wagner College's thesis symposium.

My hope is that we will learn how to better help students succeed in math word problems. If you have any questions about the study, please contact me (brian.doxey@wagner.edu, 631-835-0221) or Karen DeMoss (Karen.demoss@wagner.edu, 718-420-4070).

I, (Print Full Name)_____, am agreeing for Brian Doxey to conduct this study with my support in my class. I understand he has appropriate NYC DOE and Wagner College human subjects permissions.

Teacher's Signature:_____ Date:_____

Appendix VI: Assignment #1

Name:_____ Date:_____
Assignment 1.1

Instructions: Answer each problem and show all work:

1.) This year you got a 5% raise. If your new salary is $45,000, what was your salary before the raise?

[Show your work]

Your Answer_____

2.) It costs $250 to carpet a room that is 14 ft. x 18 ft. How much does it cost to carpet a room that is 9 ft. x 10 ft.?

[Show your work]

Your Answer_____

3.) It costs $12 to get into the San Diego County Fair and $1.50 per ride. If Rena spent $24 in total, how many rides did she go on?

[Show your work]

Your Answer_____

4.) The sum of angles in a triangle is 180 degrees. If the second angle is twice the size of the first angle and the third angle is three times the size of the first angle, what are the measures of the angles in the triangle?

[Show your work]

Your Answer_____

Appendix VII: Assignment #2

Name:_____ Date:_____
Assignment 2.1

Instructions: Please go to www.khanacademy.org . Type into the search bar "Word Problem Solving Plan 1." Watch the video and then answer each of the following problems and show all work:

1.) This year you got a 15% raise at your job. If your new salary is $50,000, what was your salary before the raise?

[Show your work]

Your answer_____

2.) It costs $300 to paint a 10 ft. x 12 ft. wall. How much would it cost to paint an 8 ft. x 10 ft. wall?

[Show your work]

Your Answer_____

3.) It costs $9 to get into the local carnival and $1.75 for each game. If David spent $23 in total, how many games did he play?

[Show your work]

Your Answer_____

4.) The sum of angles in a triangle is equal to 180 degrees. If the second angle is 3 times as large as the first angle and the third angle is 5 times as large as the first angle, what are the measures of each angle in the triangle?

[Show your work]

Your Answer_____

Appendix VIII: Questionnaire #1

Name_____Date:_____
Questionnaire 1.1

1.) Have you ever done a math word problem before?
Circle your choice:

Yes No

2.) When you think of word problems, what 3 words come to mind?
1. _____
2. _____
3._____

3.) How good are you at word problems? (Circle a number between 1 and 10)

REALLY BAD OKAY SUPER GREAT

1 2 3 4 5 6 7 8 9 10

4.) Do you own a computer, tablet, cell phone, or any device that can connect to the Internet at your home?
Circle your choice:

Yes No

5.) List these subjects in order of your favorite subject to least favorite subject:
Science, Social Studies, Math, English Language Arts, Gym, Art, Music

1.)_____ (Favorite)
2.)_____
3.)_____
4.)_____
5.)_____
6.)_____
7.)_____ (Least Favorite)

6.) Do you enjoy using technology in the classroom?
Circle your choice:

Yes No

7.) Have you ever used the Internet at home for help on math homework?
Circle your choice:

Yes No

Appendix IX: Questionnaire #2

Name:_____ Date:_____
Questionnaire 2.1

1.) Were you able to use the Khan Academy website?
Circle your choice:

Yes No

If not, why not?

_____
_____
_____

2.) If you used the Khan Academy website, how many times did you watch the word problem video for help?
Circle your choice:

1 2 3 4 5+ Did not watch any videos

3.) On a scale of 1 to 10, where 1 is not helpful and 10 is very helpful, please rate how much Khan Academy helped you:
Circle your choice:

1 2 3 4 5 6 7 8 9 10

4.) Will you use the Khan Academy website for future lessons that you find difficult or that you don't fully understand?
Circle your choice:

Yes No Maybe

5.) When you think of word problems, what 3 words come to mind?
1. _____

2. _____
3. _____

6.) How good are you at word problems? (Circle a number between 1 and 10)

REALLY BAD OKAY SUPER GREAT

1 2 3 4 5 6 7 8 9 10

Appendix X: Word Problem Word Associations List #1 (Question #2 of Questionnaire #1)

add	equally	multiplication	solution
add/subtract	estimate	multiply	solve
add/subtract	expanded form	multiply	solve
adding	explain	multiply	solve
addition	expression	multiply	solve
addition	fail	multiply	solve
all together	fraction	multiply/divide	solving
bored	fractions	not exciting	solving
boring	fractions	not fun	steps
breakdown	fractions	numbers	strategy
check	fractions	numbers	substract/add
check	fun	numbers	subtract
cluewords	fun	numbers	subtraction
cluewords	hard	numbers	subtraction
cluewords	hard	numbers	succeed
cluewords	hard	of	think
confusing	hard	of	think
coordinates	hard	of	think
correct	how	operation	thinking
correct	how	operation	together
crazy	how many more	operations	total
decimals	how much	operations	try
difference	how much more	operations	underline
difference	in all	operations	underline
divide	in all	operations	vocabulary
divide	in all	operations	what
divide	interesting	pass	what to do
divide/multiply	key words	pemdas	what to do
division	keywords	problem	words
division	know	problem	work
division	knowing	question	work
division	learned	questions	work
divisor	left	re-reading	X—No Response
do	math	read	X—No Response
each	math	read carefully	X—No Response
each	multi-step	sequence	X—No Response
easy	multiplication	signal words	
easy	multiplication	solution	
equally	multiplication	solution	

Appendix XI: Word Problem Word Association List #2 (Question #6 of Questionnaire #2)

about
about
adding
addition
addition
addition
addition
addition
all together
all together
all together
all together
answer
answer
answer
answer
boring
challenging
confusing
difficult
difficult
difficult
divide
divide
divide
divide
division
division
division
each
each
each
each
each
easy
easy
easy
easy

easy
easy
equation
equation
equations
equations
equations
estimate
estimation
excitement
fair
finishing
fun
hard
hard
hard
hard
hard
hard
helpful
how long
how many
how many
how many
how much
how much
how to
in all
in all
key words
keywords
math
multiply
multiply
multiply
multiply
multiply
multiply

multiply
multiply
multiply
multiply
normal
not fun
number
number sentence
numbers
numbers
numbers
numbers
numbers
numbers
numbers
operation
operation
operation
operation
operation
operation
operations
operations
operations
operations
operations
operations
problem
problem
problem
problems
slow
solution
solution
solutions
solve
solve
specific

steps
steps
strategy
strategy
strategy
subtraction
subtraction
subtraction
subtraction
thing
think
too long
too many
total
total
total
underline
underline
understand
what
what
work
X--- NO RESPONSE
X--- NO RESPONSE
X--- NO RESPONSE
X--- NO RESPONSE
X--- NO RESPONSE

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Department: Education

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