EFFECTS OF INSTRUCTIONAL VIDEOS AND REAL-LIFE MATHEMATICS ACTIVITY ON STUDENT ACHIEVEMENT AND ATTITUDE IN A COMMUNITY COLLEGE TRANSITIONAL MATHEMATICS COURSE

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ABSTRACT

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This study investigated the effect of instructional videos and real-life activities on the mathematical achievement and attitude of developmental students. The study also investigated the attitude of developmental students towards learning mathematics through instructional videos and real-life activities. The study was conducted at an urban community college with transitional mathematics classes. The four mathematics classes in the study received various combinations of real-life activities, instructional videos, and traditional teaching while studying basic concepts such as decimal place value, percentages, and fractions. Pre-and post-tests were conducted to measure student achievement. Attitude scales, surveys, and interviews were used to measure attitude changes. Results showed that, overall, the mathematics achievement of the classes receiving consistent exposure to videos and real-life activities was greater than classes receiving only some of the special instructional treatments. Students interviewed believed that instructional videos and real-life activities improved their understanding of the mathematical concepts involved in the study.

DEDICATION

To my husband, Mani Gopalakrishnan

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Chapter I

INTRODUCTION

Need for the Study

Community colleges are in demand due to their open enrollment, affordability, and easy accessibility. According to the Advisory Committee on Student Financial Assistance (2008), nationwide 1200 community colleges serve about 11.5 million students – close to half of all undergraduates.

Unfortunately, about 60% of American college students are not ready for college-level work and need remedial course(s) in their first year at college (Attewell, Lavin, Domina, & Levey, 2006; Bailey, 2009; Bailey & Cho, 2010; Grubb et al. 2011; McCabe, 2003). The entire nation is facing the challenge of remedial, or developmental, education. Although remedial programs are important to prepare students for their early college years, they cost institutions and government billions of dollars annually (Levin & Calcagno, 2008). The cost is also borne by students who do not receive academic credit for remedial work but still have to pay fees and tuition, which means delaying their graduation and paying more.

More than 50% of community college students enroll in remedial programs, but less than 25% of those students earn degrees or certificates (Bailey & Cho, 2010). More specifically, in the State of Connecticut, about 66% of students entering community colleges and 20% of students entering state colleges need remedial mathematics/English courses; of these students only 8% get a certificate or degree within three years (Act

Concerning College Readiness and Completion, 2012). Many students are not college ready, and remedial programs are not effective for them, which means a waste of time, energy, and money. Apart from the loss, such an outcome is dangerous for our economy because the nation's future adults will not be ready to meet the needs and expectations for an educated work force.

In 2012 the Connecticut General Assembly took action and passed "Public Act 12-40, an Act Concerning College Readiness and Completion" to redesign the state's remedial education system. The goal of the act was to have short and effective remedial programs, ensuring that students get credentials and degrees. The act put forth a three-tier system for remedial education consisting of an embedded level, an intensive level and a transitional strategies level. Students are placed in a level based on their skills. The embedded level is for students with a 12th grade, or close to a 12th grade, skill level and consists of college-level courses with embedded support. The intensive level, for students with less than 12th grade skills, includes one semester of developmental education or intensive readiness experience. The transitional strategy level is for students with an 8th grade or lower skill level. It is basically a pre-enrollment program for students who need more than one semester of remediation (Senserrich, 2014). In 2013 the Connecticut General Assembly and Board of Regents provided financial support to test the tier system and to hire new faculty and guidance counselors at each affected campus.

The students of the bottom tier, or transitional strategy level, are the biggest concern for the State of Connecticut and the nation as a whole. Without meeting the needs of this group, it will be difficult to increase the number of college graduates by 5 million by 2020, a goal set by President Obama in 2010. The students of this tier struggle the most to graduate since they are least prepared for college-level courses. Porter (2014) recently quoted Hunter Boylan, Director of the National Center for Developmental Education, to the effect that these students have low college graduation rates and we have not learned how to serve them best yet. Because Public Act 12-40 is fairly new, it is virtually unstudied by researchers.

Mathematics and Community Colleges

Mathematics is important not only for day-to-day activities but also for higher education and career opportunities (Martin, 2003). According to the STEM Education Caucus, soon all jobs in America will require a basic knowledge of mathematics (Feder et al., 2011; STEM Education Caucus Steering Committee, 2010). The US Bureau of Labor and Statistics predicted that by 2018 the United States will have about 1 million STEM related job openings. There is a clear need to prepare students mathematically but unfortunately mathematics has been considered an obstacle to graduation for many community college students (Dorr, 2012; Stigler, Givvin, & Thompson, 2010). In order to meet the goal of "5 million graduates from community college by 2020" (US White House, 2012; Weinstein, 2010) it is worth conducting studies to analyze such students' mathematics performance and attitude.

Key Concepts: Fraction, Decimal, and Percent

Since 1973, the National Assessment of Educational Progress (NAEP) has measured the mathematics performance of 13 and 17-year-old students. The results from the 2012 NAEP long-term assessments, as compared to the results of 1973, show no significant change in the scores of 17-year-old students and only 19 points improvement for 13-years old students. For decades the results of National Assessment of Education Progress (NAEP) have shown that many students in the nation struggle to understand the concepts of fractions, decimals, and percent. The knowledge and understanding of all three sub domains of rational numbers sets the foundation for success in algebra and other advanced mathematics courses (Behr, Lesh, Post, & Silver, 1983) and have been the focus of the mathematics curriculum in remedial mathematics courses. The majority of students entering community college have never mastered fractions (Gal, 2000), decimals, and percent in their K-12 schooling. They are underprepared and, at the institution involved in this study, end up in the transitional strategy level. Most of the relevant research has focused on fractions (Alexander, 2013) or algebra (Huang, 2008; Martelly, 1998; Peel, 2010; Thompson, 2008) but this study has addressed all three sub-domains.

Developmental Students

Developmental students are generally taught using traditional lecture methods. This approach to teaching is in direct contradiction to the research suggesting that most developmental students are active, visual, and hands-on learners. They learn best if the content is taught using real-life examples to which they can relate (Bollash, 2013; Canfield, 1976; Lemire, 1998; McCarthy, 1982).

Additionally, many studies recommend the use of a variety of teaching practices to reach the different types of developmental students (Boylan, Bonham, Claxton & Bliss, 1992; Caazza & Silverman, 1996; Cross, 1976; Kulik & Kulik, 1991; McCabe & Day, 1998; Roueche, 1968; Roueche & Wheeler, 1973;). Waycaster (2001) suggests using at least two modes of instruction for developmental students.

Research suggests that using technology as a supplement to instruction is more effective than using it as the main source of instruction (Boylan, Bonham, Claxton & Bliss, 1992). Rapid change in the field of technology and its easy availability for students and schools are forcing us to change our teaching and learning styles. A simple Google search will uncover numerous short instructional videos on virtually any mathematical concept. These videos are often about 5 minutes or less in length.

In 1995 and again in 2006 AMATYC (American Mathematical Association of Two-Year Colleges) emphasized integrating technology into developmental mathematics classes. The Center for the analysis of postsecondary readiness (CAPR) study is exploring the use of learning technologies in developmental mathematics which emphasize on interactive instructional software and personalize assistance (Boatman, 2018) Some mathematics developmental classes used software (such as MyMathLab-MML and PLATO) or adopted the flipped classroom approach. In a flipped classroom, as opposed to traditional, approach instruction takes place outside the classroom, often online, but activities or homework takes place in the classroom. Other developmental courses offered computer-based or distance learning courses. There have been mixed results and recommendations. With the Khan Academy, YouTube, and many other video-based solutions, videos have emerged as a potent force. Videos are considered a powerful medium for learning (Betrancourt, 2005; Girod, Bell, & Mishra, 2007). Research shows that many students taught through the lecture method are unable to retain information and find it challenging to use what they have learned to solve new problems (Mayer, 2002).

AMATYC also stressed that the material in developmental mathematics classes should focus on true-to-life situations. Visual and real-life applications are considered best practices in developmental mathematics (Cafarella, 2014). Galbraith and Jones (2006) also discovered that connecting mathematics concepts with real-life situations promotes learning in developmental mathematics courses. For instance, in the Galbraith and Jones study, the instructor connected concepts of personal finance, checkbook balancing, and calculating pay with classroom mathematics, helping students to understand and apply classroom mathematics to their own personal world.

Although literature identifies visual, hand-on, and real-life examples as the most effective teaching techniques for developmental education, no research study has combined visual approach and teaching through real-life examples with the traditional lecture approach for students at the transitional strategy level.

Purpose of the Study

The purpose of this study was to analyze the effect of instructional videos and real-life mathematics activity assisted instruction on achievement in and attitude toward mathematics in a transitional mathematics course at an urban community college. My study will contribute to a statewide experiment seeking to identify the best practices and strategies for effective remedial programs in Connecticut Community Colleges. The study will seek answers to the following questions:

1. What are the experiences of students participating in two different instructional interventions related to decimal, percent and fraction concepts?
2. Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematics achievement of students when compared to

   a. a traditional method
   b. supporting traditional instruction with instructional videos alone
   c. supporting traditional instruction with real-life activities alone

3. Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on mathematical attitudes of students?
4. What are transitional mathematics students' attitudes towards the use of instructional videos and real-life activities in their mathematics course?

Procedures of the Study

This study examined change in students' mathematical achievement and attitude with regard to the use of mathematics instructional videos and real-life activity assisted instruction. Student attitude was determined through pre- and post-survey, interview responses, observation notes, and anxiety subscale; student achievement was determined by pre- and post-tests which was designed by the researcher.

Setting for the Study

The study was conducted at a Connecticut urban community college with a diverse population. The college enrolls more than 6000 full and part-time undergraduates. The college is accredited by New England Association of Schools and Colleges, and many of its courses are accredited by national professional associations. The college focuses on a "hands-on" and a "put education to work" approach to learning. Most classrooms are equipped with the latest available technology.

Selection of Participants

The study focused on the students enrolled in transitional (or developmental) mathematics course. Such students generally have an 8^{th} grade or lower skill level, need remedial education for more than six months, and struggle to complete college. Some of these students are recent high school graduates, but most of them are returning adult learners.

Achievement

Achievement measures were based on pre- and post-tests created by the researcher. The test questions were designed to assess knowledge, comprehension, and application of each mathematical concept. (See Appendix A for pre- and post-tests.)

This study employed a Decimal Video and Percent Activity (dVpA) as well as a Decimal, Percent, Fraction Activity and Video (dpfAV) group. As shown in Table 1.1, the dVpA group received no real-life mathematics activities for the first concept, no instructional video for the second concept, and neither instructional video nor real-life mathematics activities for the third concept.

Table 1.1
Format of lessons: dpfAV vs dVpA Group

Mathematical Concept	**dpfAV Group**	**dVpA Group**
Decimal (Place Value)	Video & Activity	Video only
Percent (Discount)	Video & Activity	Activity only
Fraction (Adding Fractions)	Video & Activity	Traditional

Attitude

The Attitude towards Mathematics Inventory (Tapia, 1996) and Mathematics Self-Efficacy Survey (Betz & Hackett, 1983; Clutts, 2010) were used to create a survey for this study. (See Appendix B for the survey.) Cronbach's alpha was calculated to check the reliability of the instrument. The anxiety subscale of Fennema Sherman Mathematics Attitude Scale was also used to get additional data on student attitudes.

Interview

All the students who volunteered for the study also agreed to be interviewed. Due to time constraints, I interviewed only those students who were available in the last two weeks of their 5-week course. Interviews with selected students were conducted to supplement survey and test data in order to help further understand student attitudes towards mathematics, instructional videos, and real-life mathematics activities.

Chapter II

LITERATURE REVIEW

Introduction

In this chapter, I provide a review of literature related to three main categories: (1) teaching and learning of mathematics in the developmental classroom; (2) cognitive theory of multimedia learning; and (3) mathematics anxiety and attitudes towards mathematics.

In regards to teaching and learning mathematics, first, I analyze literature concerning instructional methods used in developmental classrooms, focusing on the ones that discuss real-life applications in mathematics. Next, I review the literature on the use of technology, specifically instructional videos, in developmental education. I provide a context of how and why the use of technology became popular and then discuss its influence on teaching and learning in developmental education. Next, I review literature that focuses on Mayer’s extensive research on multimedia learning. I describe the eight design principles that I have used as guidelines to select instructional videos for developmental mathematics classrooms. Finally, I analyze literature on mathematics anxiety, attitudes towards mathematics, and the relation between them. The literature highlights that anxiety and attitude are not the same but that they influence each other.

Knowing that quality of instruction tends to be positively correlated with students’ academic performance (AMATYC, 2006; Boylan, Claxton & Bliss, 1992; Creemers & Kyriakides, 2012), the American Mathematical Association of Two-Year Colleges (AMATYC) published their first standards document, *Crossroads in*

Mathematics: Standards for Introductory College Mathematics in 1995. It includes principles and standards for teaching mathematics in two-year colleges. Though published in 1995, the standards are still widely accepted today. In 2006 the AMATYC released its second standards document, *Beyond Crossroads.* In *Beyond Crossroads* the AMATYC introduced five implementation standards which are basically guidelines for improving mathematics education. One of the implementation standards is entitled "Instruction." It promotes active learning and expects mathematics faculty to use a variety of instructional strategies to meet the diverse needs of students in mathematics courses.

Research also supports using a variety of instructional methods to meet the needs of developmental programs (AMATYC, 2006; Boylan, Bonham, Claxton, & Bliss, 1992; McCabe, 2003; McCabe & Day, 1998; Silverman & Casazza, 1999). Boylan (2002) reported that according to the Continuous Quality Improvement Network (CQIN) and the American Productivity and Quality Center (APQC), instructors at best-practice institutions use at least three different instructional strategies in every class; the lecture method can be one of the modes since instructors are comfortable and experienced with it. Research studies in developmental mathematics have identified several instructional strategies that are effective and improve student learning, such as connecting mathematics concepts with real-world situations, collaborative learning, working in small groups, guided inquiry, supplemental instruction, and computer-based instruction (Boylan & Saxon, 2006; Cafarella, 2013; Finney & Stoel, 2010; Galbraith & Jones, 2006)

Learning Styles of Developmental Students

Lemire (1998) conceptualizes three basic learning styles: visual, auditory, and haptic. Visual refers to learning by seeing, looking and observing; auditory refers to learning by listening, talking and interacting; and haptic refers to learning by doing, making, practicing, and actively engaging in the content. Good instruction, in Lemire's view, should include some components of all three learning styles.

Visual Learners

Visual learners learn best when the learner can see the content in visual form: posters, films, pictures, diagrams, flow charts, time lines, videos, and demonstrations (Felder & Solomon, 1991). During the 30 years Lemire has been researching and studying learning styles, he has collected descriptive data showing the visual learning style preference of different groups. In 1987, Lemire conducted a study at the University of Wyoming and found that 52% of the university students were visual learners. In 1995 he surveyed college students, using a different instrument, and found that 84% of the students were visual learners. In 1998, his survey of community college students showed that 62% of the students preferred a visual style (Lemire, 1998).

Auditory Learners

Auditory learners learn best when the content is presented in text or spoken words (Felder & Solomon, 1991). Most remedial class instruction includes lecture methods, a form apparently well suited for auditory learners.

Active Learners

Research suggests that developmental students are active learners (Bollash, 2013; Boylan & Saxon, 2006; Stigler, Givvin, & Thompson, 2009). Such learners assimilate content best by doing something active with it (Felder & Solomon, 1991). Students can be engaged in the content by discussing or applying it or explaining it to others, interacting or questioning, and through collaborative or cooperative learning during which they are engaged in activities designed to help them develop conceptual understanding. Given a choice, active learners select group work or hands-on projects.

At a New England community college, Bollash (2013) found that close to 70% of the developmental students were active learners. The goal of Bollash's study was to identify the learning styles of developmental students using the "Index of Learning Style" instrument.

Real-Life Application/Activity

In 2006, President Bush established the National Mathematics Advisory Panel, responsible for providing suggestions to improve mathematics education in the United States. The President expected suggestions to be based on available scientific research.

The panel reviewed more than 1600 research publications and policies and provided their findings and recommendations on curriculum content, learning process, teacher and teacher education, instructional practice, instructional material, assessment, and research policies and mechanisms (National Mathematics Advisory Panel, 2008). One of the findings and recommendations for instructional practices advocates the use of real-world situations to introduce mathematical ideas. The panel found a lack of high quality studies in this field; only 10 were related to the use of real-world problems to teach mathematics.

The panel noted that the meaning of the term “real-world” problem is different for researchers, mathematicians, curriculum developers, and teachers. Also, they found it challenging to assess how well the “real-world” context was implemented by teachers or how well teachers were prepared and able to teach such material. Based on the literature review the panel found that if students are taught using “real-world” situations, then their performance for similar real-world problems improves, but the performance in areas such as computation, solving simple word problems and solving equations does not improve. These results were deemed insufficient to make any recommendations for the nation’s children, suggesting the need for additional research.

Teaching methods used in mathematics classrooms often consist of tricks or algorithms to solve problems, procedures that students can memorize rather using steps that make sense. Further, class instruction tends to be dominated by the lecture method (Boylan, 2002; Stigler, Givvin & Thompson, 2010), which students can find boring and useless for real-life, ultimately leading to low success rates.

To fight this battle, many research studies and articles have identified best teaching practices in developmental mathematics (Armington, 2002; Bonham & Boylan, 2011; Boylan & Saxon, 2006; Cafarella, 2013; Galbraith & Jones, 2006; Kishawi, 2015;) and have suggested principles for effective teaching in developmental education (Smittle, 2003). The research studies have discovered that relating developmental mathematics to real-life situations improves learning (Alexander, 2013; Armington, 2002; Bonham & Boylan, 2011; Boylan & Saxon, 2006; Byrk & Treisman, 2010; Cafarella, 2013;

Galbraith & Jones, 2006; Kishawi, 2015; McMillan, Parke, & Lanning, 1997; Merseth, 2011).

In an attempt to connect classroom mathematics with day-to-day mathematics, the Rational Number Project's modified version (Lesh, 1983) suggests that to solve any realistic mathematics problem, it should be first translated from a real-world situation to some system of representation, then operated on within the field of representation to get results, and, finally, the results should be translated back into a real-life situation (Behr, Lesh, Post, & Silver, 1983).

Galbraith and Jones (2006) and Cafarella (2013) offer similar advice to those using real-life activities in developmental mathematics: instructors should connect developmental mathematics content to real-life situations to make mathematics more meaningful for students, helping them to understand, retain, and apply the information. Cafarella (2013) regarded real-life applications as among the best practices in developmental mathematics. His study also stressed that the use of real-life applications enhances success for most developmental students.

Alexander (2013) studied students' foundational fraction understanding at a community college in northern California and found that students consider real-life applications very valuable to their course success; furthermore, they believe that it improves their understanding of the content.

McMillan, Parke, and Lanning (1997) at the College of Lake County (Illinois) suggest that teaching which applies basic skills to real life is a characteristic of effective remedial programs. Baron (2015) considers that teaching mathematics through real-world problems makes mathematics less intimidating.

In addition to research support, other initiatives also support real-life applications in mathematics courses. In September 2009 the Carnegie Foundation for the Advancement of Teaching started a $13 million initiative to develop two pathways for developmental mathematics students: Statway and Quantway (Cafarella, 2013; Clyburn, 2013; Merseth, 2011). The goal of the initiative is "to double the proportion of students who in a 1-year course sequence are mathematically prepared to succeed in further academic study" (Merseth, 2011, p. 32). Byrk and Treisman (2010) noted that Statway emphasizes real-world mathematics as an aid to students in their day-to-day activities. Merseth (2011) observed that in Quantway "students use numerical reasoning for decision making, argumentation, and sense making about real-world questions and problems in contexts of personal, social, and global importance" (p. 33). The focus of both Quantway and Statway is to help students use mathematics to make sense of the world around them; both pathways emphasize understanding and applying mathematical concepts rather than memorizing disconnected processes and procedures (Byrk & Treisman, 2010; Merseth, 2011).

Rational Number Concepts – Fraction, Decimal, and Percent

Fractions, decimals, and percentages are subdomains of the rational numbers. Knowledgeable professionals argue that the decimal system is "incredibly powerful" and "fractions set a foundation for decimals" (Behr, Lesh, Post, & Siler, 1983; Fennell, 2007; NCTM principles and Standards, 2000, USA Today, 2008). It is generally agreed that fractions, decimals, and percentages should be taught in connection with each other (Lembke & Reys, 1994; Mathematics Framework for California Public Schools, 2013;

Sharp, 2002; Stigler, Givvin & Thompson, 2009; Sweeny, Quinn, 2000). Lembke & Reys (1994) found that students who did not have a good understanding of relationships among fractions, decimals and percentages had limited or no success with percent problems irrespective of problem type and context.

Behr, Lesh, Post, and Silver (1983) explained the importance of rational numbers from a practical, psychological, and mathematical perspective. According to those authors, rational numbers improve the individual's ability to handle real-world problems, expand mental structures, and set the foundation for algebra. Although rational number concepts are important, they are complex concepts as well as abstract concepts that students are taught in their elementary school years. Woodward, Baxter, and Robinson (1999) found that low-achieving students require considerable time, much longer than 2 to 3 months, to grasp rational number concepts.

The challenge of learning and understanding rational number concepts is a universal problem, and it can become an obstacle to further student growth in the field of mathematics. The National Study of Community College Remedial Education (NSCCRE) found that mathematics is the greatest hurdle for remedial students. Results of the National Assessment of Education Progress (NAEP) also show that students find it challenging to understand and apply rational number concepts (Carpenter, Coburn, Reys, & Wilson, 1976; Carpenter, Corbitt, Kepner, Lindquist, & Reys, 1980). For instance, only one third of 13-year-olds and only two thirds of 17-year-olds could add fractions with unlike denominators. Similarly, Novillis-Larson (1980) found that students could place proper fractions on a one-unit long number line when the number of segments were equal to the denominator, but only 25% of the sample placed fractions correctly on a number line that was two units long. Further, the Trends in International Mathematics and Science Study (TIMSS) shows that students in the United States do not perform well on rational number concepts (Glasgow, Ragan, Fields, Reysi, & Wasman, 2000). Stigler, Givvin, and Thompson (2009) found that students were lacking in the basic skill of representing fractions, decimals, and percentages.

In mathematics classes generally, rational number topics tend to be taught in a highly procedural manner. Content learned through procedural knowledge is often fragile, with little to no understanding, and is often misapplied. Stigler, Givvin and Thompson (2009) found that students are so used to the procedures that they seem to believe it is inappropriate to use reasoning or strategies to solve a problem when they cannot recall the procedure. Procedures never connected with conceptual understanding are easy to forget. The Final Report of the National Mathematics Advisory Panel (2008) also emphasized the importance of the conceptual understanding of fractions, decimals and percentages and the relationship between these topics. The panel recommended that teaching rational number concepts be acknowledged as a critically important component in increasing students' algebra achievement.

With support from the National Science Foundation (NSF), the Rational Number Project (Behr, Cramer, Harel, Lesh, & Post, 1990) promotes teaching rational numbers using a model that emphasizes multiple representations and connections among these representations. Studies found that visual representations and knowledge of area concepts helped students to grasp rational number concepts (Owens, 1980; Sambo, 1980; Woodward, Baxter, & Robinson, 1999). Stigler, Givvin and Thompson's (2009) study supports the link between conceptual understanding, reasoning, and logical connections and the success of developmental students. The study found that developmental mathematics students are very capable; they will do well if they are given an opportunity to reason. The study recommends that teachers provide tools to encourage students to think and to make connections. The teacher should ask questions that call for reasoning and thinking skills and that cannot be solved with standard procedures. The procedures should be developed through reasoning and making connections. Procedures should be seen as an efficient way to solve problems, and each step should make sense to students.

Technology in Developmental Education

The use of technology in the field of education is increasing tremendously, but the appropriate and effective use of technology is a topic of great discussion. According to Rapp and Gittinger (1993) the real question regarding the use of technology in education is not “whether to use computers in education, but how” (p. 11). Several studies evaluated the use of technology in developmental education with mixed results and conclusions. Holton, Muller, Oikkonen, Valenzuela, and Zizhao (2009) reported that students enrolled in a technological version of mathematical courses performed half a grade better than the students enrolled in a traditional mathematics course. McClendon and McArdle (2002) tested three modes of instruction: traditional lecture, Academic Systems (an Internet-accessed software curriculum that provides students with combinations of lectures, practice programs, and self-administered assessment tests), and ALEKS (a non-linear, non-traditional Internet-based course). The study found no significant difference in outcomes by mode of instruction. Wilson (1992) and Moore

(1993) reported that the mathematical achievement of computerized remedial program students was greater than that of traditional program students.

Overall, the explosion of educational technology has had a dominant effect on instructional delivery methods. Technology has encouraged teachers to re-think their teaching methods for the benefit of students. Brothen (1992) reports that computers can be very useful in developmental classrooms, especially for those who need more individual attention than the teacher can provide. In 2000, Maurer reviewed the prediction he made in 1984 about technology and indicated that technology did not replace instructors but assisted and improved human instruction. Keup (1998) also noted that technology does not replace instructors but changes the role of instructor to that of facilitator. Keup also reported that technology can promote collaborative learning in developmental education. Kulik (1994) analyzed more than 500 individual research studies of computer-based instruction and found that such instruction helps students learn more in less time; in addition, students develop more positive attitudes towards classes. Several studies encourage faculty and students to understand the benefits of using technology in the classroom, but the decision to use technology in any classroom depends on each individual instructor, and Johnson and Johnson (1996) reported that educational communities tend to be very slow in adapting technology and very quick to discontinue its use.

Teaching through technology is becoming prevalent in community colleges, where more than 50% of the students take at least one online course and online enrollment is growing 10 times faster than the enrollment in higher education as a whole (Mesa, Wladis, & Watkins, 2014). Though technology plays a crucial role in the teaching and learning of mathematics at community colleges, the National Study of Developmental Education advises that computer technology in developmental courses should be used to support classroom instruction and not to replace it (Boylan, Bonham, Claxton, & Bliss, 1992; CQIN/APQC, 2000).

Instructional Videos

Information technology, which is transforming our world, as well as the changing demographics of the US population, demand more from developmental education than just preparing students for bachelor's degrees (McCabe 2000). Technology is also influencing instructional materials and delivery methods. It is influencing the way students learn. Research suggests that an exposure to technology is affecting people's attention span—the more they are exposed the greater the decrease in their attention span (Microsoft Cooperation, 2015; Postman, 1985; Purcell et al., 2012). To attract learners' attention, integrating videos in classroom teaching has been suggested, and literature supports that instructional videos can accommodate the needs and preferences of young students (Berk, 2009; Donker, 2011; Girod, Bell, & Mishra, 2007; McCabe, 2000; Pai, 2014).

Instructional videos tend to be short and are designed to teach a specific skill (Pai, 2014; Shipper, 2013), but they are neither dynamic software nor interactive. Videos are short (3-4 minutes) and to the point, designed to focus on one or two main ideas. They are designed with the intent to hold viewers' attention for the duration of the video, and a single one can provide knowledge about several topics. Integrating instructional videos into the classroom is not a new concept but one that is increasingly popular (Shipper, 2013).

It is true that in the past few years the availability and usage of online videos have grown exponentially. The role of videos or non-textual resources is expanding in the field of teaching, learning and research (DeCesare 2014; Johnson, Adams, and Cummins, 2012; Pai, 2014). One reason could be that videos work well for the human brain. Research says that every human brain has three core intelligences – verbal, visual, and musical (Gardner, 1983, 1993, 1999, 2005; Gardner & Hatch, 1989; Kagan & Kagan, 1998; Marks-Tarlow, 1995; Williams, Blythe, White, Li, Sternberg, & Gardner, 1996) and videos include all three. Videos also engage both left and right brains (Berk 2009). The left brain is seen as the verbal, mathematical, and logical side (Miller, 1997) whereas the right brain is viewed as non-verbal, creative, and musical (Jourdain, 1997; Polk & Kertesz, 1993).

Projects like "Click & Go Video" of the Joint Information System Committee (JISC) (Thornhill, Asensio, & Young, 2002) provide rich information on video streaming as well as guidance to enhance the use of video streaming in education. Homes, Clark, Burt, and Rienties (2013) reported that the JISC project identified five value-added characteristics of videos in education: visualization- video as a moving image helps students to visualize a process better than the text or verbal format; illustration- video enhances the power of a still image; validation- video reinforces and validates content knowledge through moving images; explanation- video explains the process or event through a "show and tell" style; and motivation- video motivates students by making content alive through moving images. Berk (2009) listed 20 values of using videos in classrooms: grabbing students' attention; focusing students' concentration; generating interest in class; creating a sense of anticipation; energizing or relaxing students for learning exercises; drawing on students' imagination; improving attitudes toward content and learning; building a connection with other students and the instructor; increasing memory of content; increasing understanding; fostering creativity; stimulating the flow of ideas; fostering deeper learning; providing an opportunity for freedom of expression; serving as a vehicle for collaboration; inspiring and motivating students; making learning fun; setting an appropriate mood or tone; decreasing anxiety and tension on scary topics; and creating memorable visual images.

The usage of videos has increased due to the benefits of videos and their apparent connection with the human brain. In 2009, Kaufman and Mohan reported that 40% of the faculty surveyed believed they would use more online video in the future. In 2012, Moran, Seaman and Tinti-kane reported that 90% of surveyed faculty find videos online for teaching purposes. About 41% of faculty in traditional classes (as opposed to online and blended classes) used videos regularly. The 2013 "Online Video 2013 Report" from the Pew Research Center reported that the percent of adults with online access who watch or download videos has increased from 69% in 2009 to 78% in 2013. People from ages 18-49 watch online videos at the highest rate. YouTube is the driving force among adult users for posting, watching, and downloading online videos (Purcell, 2013). Pai (2014) also recommended YouTube, Google videos, PBS, and several other educational websites as the easiest way to start locating videos for teaching, as many videos are already available for free on such sites

YouTube originated in 2005. In 2016, the Statistics Brain Research Institute reported that the "hours of video uploaded per minute" on YouTube has increased from 13 hours in 2008 to 300 hours in 2016; YouTube is the third most visited website in the world. Almost 5 billion videos are watched on YouTube every single day. Kaufman and Mohan (2009) reported that for 17% of faculty the primary source for videos is YouTube. The study also reported that faculty identified many obstacles to video usage, such as not having quality/appropriate material (43%), not having one central place to find videos (10%) and more. Similarly, Holmes, Clark, Burt, and Rienties (2013) reported issues with YouTube, particularly finding appropriate content, and the ethical issue regarding uploading student material to a place which is publicly accessible. Jones and Cuthrell (2011) refer to this as the two sides of YouTube. On one side it is a treasure, an excellent source of online videos for teaching and learning; on the other side, it is a vast wasteland of garbage - inappropriate, unreliable, disrespectful videos.

Regardless of the challenges, it is obvious that the production and consumption of videos is exploding. In 2014, Pai reported that videos are considered a most powerful medium of learning. Similarly, Sherer and Shea (2011) encouraged faculty and students to incorporate online videos in college courses to enhance lectures, assignments, class discussion, class examinations, and at the same time help students achieve the learning objectives of the course. A recent study by Allison (2015) reported that 85% of teachers use instructional videos, typically once a week, and even more use them once a month. The study also found that teachers use videos to reinforce, to motivate, and to provide authentic content. According to teachers, the advantages of using instructional videos are maximizing instructional time, using multi-modal instruction, and fostering motivation.

Cognitive Theory of Multimedia Learning

"A picture is worth a thousand words." The quotation's author is unknown, but people use it frequently to emphasize the importance of visualization.

Mayer's (2002) and Fadel and Lemke's (2008) research on the intertwined relation between how the brain functions (neuroscience), how people learn (cognitive science), and multimedia design reports that visualization has become increasingly important in learning. Students who use a well-designed combination of visual and text appear to learn more than the students who use text only.

The human brain processes information in several steps involving perception, attention, selection, organization, and integration (Elliot 2008). The long-term memory of the human brain is the center of the processing system, where new knowledge either becomes integrated with previous knowledge or is organized as new knowledge. Information in the long-term memory is organized in small chunks known as schemas (Elliot, 2008). If the knowledge does not reach long-term memory, it is lost; in other words, the human brain simply does not integrate or record such information, and it is forgotten after a short period of time.

Before heading to the long-term memory, information is processed in the working memory. Working memory is very limited. It can process roughly seven pieces of information at one time (Miller, 1956) and can retain the information for only about 20 seconds.

Working memory contains several channels, such as the auditory channel that processes information which is heard and the visual channel that processes information which is seen. Research suggests that the working memory's visual channels can process more information than its auditory channels, but if information is presented using both the channels, then the human brain can process more information overall. Mathematics videos use visual and audio channels to provide information, implying that with their aid, students can process more information at one time and more information can find its way to long term memory. Research also says that people learn better from words and pictures than from words alone (Mayer 2002). The relation between the ways the human brain processes and records information and the nature of videos significantly contributes to student learning. According to Charles and Lemke (2008), instruction that takes into account how the brain functions, how people learn, and the capabilities of multimedia design would provide optimal learning opportunities.

Mayer (1997) referred to multimedia learning as presenting explanations visually and verbally. Mayer's research on multimedia learning focused on comparing instructional presentation modes: words versus pictures. In order to measure a learner's understanding of the content, Mayer used "problem-solving transfer questions," which focused on students' ability to transfer learning to a new problem situation.

Richard E. Mayer and colleagues (Mayer, 2001, 2002, 2003; Mayer & Anderson, 1992, 1991; Mayer & Chandler, 2001; Mautone & Mayer, 2001; Moreno & Mayer, 1999, 2000; Moreno & Valdez, 2005) have carried out extensive research showing that multimedia (verbal and visual) instruction promotes "meaningful learning." Mayer (1997) reported that meaningful learning takes place "when learners construct and coordinate multiple representations of the same material including visual and verbal representations" (p.1). Mayer and colleagues provided their evidence through research studies in which students learned about pumps, brakes, lungs, lightning, and air lift.

Several experiments tested the conditions under which visual and verbal presentation are more effective in promoting meaningful learning. Content was presented either in a textbook-based environment or a computer-based environment. In the case of a textbook-based environment, students receive the information in a printed text (caption) and the corresponding illustration; in the case of a computer-based environment, students see a short simple animation on the screen and at the same time they hear corresponding narration. For a better understanding of the multimedia lessons Mayer and colleagues have used, I have provided a brief explanation of three of the multimedia lessons below.

How a Bicycle Pump Works

The lesson focuses on the behavior of pump parts when the handle is pulled up and pushed down. It aims to explain, for example, that when an individual pulls the handle up, a piston rises, opening an inlet valve and closing an outlet valve. The rising piston lets the air enter the pump. When an individual pushes the handle down, the piston moves down, closing the inlet valve and opening the outlet valve, which lets the air move from pump to the tire through a hose (Mayer, 1997).

How a Braking System in a Car Works

The lesson focuses on a car's hydraulic braking system. It explains that when an individual step on the brake pedal, a piston moves forward inside the master cylinder, which forces brake fluid out of the master cylinder through the tubes to the wheel cylinder; the increase in fluid pressure in the wheel cylinder activates the set of smaller pistons. These smaller pistons activate the brake shoes. When the brake shoes press against the drum, both the drum and the wheel stop or slow down (Mayer, 1997).

How Lightning Works

The lesson explains the phenomenon of lightning. The warm moist air near the Earth's surface vaporizes and rises rapidly, creating an updraft. As the air in this updraft cools down, the water vapor condenses into droplets to form a cloud. The upper portion of the cloud is made up of tiny ice crystals, and the bottom portion of the cloud is made up of water droplets. These droplets and ice crystals become too large and drag some of the air in the cloud downwards producing a downdraft. This yields the cool winds or gusts which occur before a rain. Within the cloud, the rising and falling of air currents and the collision of rising water droplets and heavy ice crystals cause positive and negative electric charges to build. The negatively charged particles fall to the bottom of the cloud and positively charged particles rise to the top. These negative charges move downwards towards the Earth like a step ladder and the positively charged particles rise above the clouds. Similarly, the positively charged particles from buildings and trees on Earth rise upwards and meet the negative charges from the clouds about 165 feet above the ground. This causes the negative charges from the cloud to flow to the ground and the positive charges from the ground to rush upwards along the same path. This upward motion of the current is the return stroke that produces the bright light that people notice as a flash of lightning.

Mayer's Eight Principles

Based on their multimedia learning theory and after an extensive study, Mayer and colleagues have suggested following eight design principles that, they argue, promote deep understanding.

Multimedia principle. The multimedia principle refers to the finding that students learn better from both words and pictures than from words alone. Mayer and Anderson (1992) examined the computer-based lesson on how brakes work. Students who received narration along with concurrent animation statistically outperformed students who received narration only. Similar results were found in other studies involving the operation of the pump (Mayer & Anderson, 1991 Experiment 2a). These results align with the cognitive theory of multimedia learning. Mayer (2002) also reported that multimedia use is consistent with Rieber's (1990) finding that students had better understanding, if animated graphics were included in a computer-based science lesson.

Contiguity principle. The contiguity principle refers to the finding that students learn more deeply when both words and pictures are presented simultaneously rather than successively. Mayer (2003) reported that, according to the cognitive theory of multimedia learning, when corresponding words and pictures are presented simultaneously, chances are greater that they will be in working memory at the same time which permits the learner to construct mental connections between them.

Coherence principle. The coherence principle refers to the finding that deeper learning takes place when irrelevant sound, words or pictures are excluded. Mayer and Harp (1997 and 1998) conducted studies in which students learned how lightning storms develop. Some groups of students received concise presentations, but the other groups received presentations with some additional interesting but irrelevant material (verbal or visual). In order to make the lesson interesting, Mayer and Harp included an option to add background music, the sound of wind blowing, or a short clip showing what happened when a golfer was stuck by lightning. Mayer stated that based on interest theory these interesting add-ons would motivate the learner to understand the narrated animation but that if these interesting add-ons were irrelevant, then they would not enhance learning. Mayer also stated that Dewey was the first educational thinker to warn against interest as some kind of a flavor that could be added to an otherwise boring lesson. Mayer also stated that according to the cognitive theory of multimedia learning, interesting but irrelevant add-ons to multimedia presentations can overload one of the channels of working memory, which can hinder the learning process.

In the studies involving lightning formation (Harp & Mayer, 1997, 1998; Mayer, Heiser, & Lonn, 2001), the concise presentation group statistically outperformed the embellished presentation group; each time, the evidence suggested that additional irrelevant material hinders student understanding.

Modality principle. The modality principle refers to the finding that more meaningful learning takes place when words are presented as narration rather than as on-screen text. According to the cognitive theory of multimedia learning, students' visual channels can become overloaded if they receive both on-screen text (words) and animation (pictures). Words presented as narration require auditory channel use and free the visual channel to focus on the animation. Studies by Mayer and Moreno (1998) and Moreno and Mayer (1999) suggest that students learn more deeply from animation and narration than from animation and on-screen text.

Redundancy principle. The redundancy principle promises deeper learning from multimedia presentations consisting of just animation and narration rather than animation, narration, and on-screen text. Using both narration and on-screen text can be justified as it gives an option to students (based on their learning style they can either listen or read the text) but, according to the cognitive theory of multimedia learning, the visual channel can get overloaded if both on-screen text and animation are present.

Personalization principle. The personalization principle refers to deeper learning when words are presented in conversational, rather than formal, style. A conversational style includes adding personal comments, targeting a particular audience, using active voice, and the like, hoping that students will feel more engaged and motivated.

Interactivity principle. The interactivity principle grows out of the theoretically deeper learning that occurs when learners are allowed to influence the presentation rate of the material. Controlling a presentation is a simple user activity where learners can feel involved. One simple user activity is including a "click here to continue" tab as Mayer, Heiser, and Lonn (2001) did in their 16-segment-long lightning formation experiments. According to the cognitive theory of multimedia learning, such feedback reduces the probability of cognitive overload and gives time for learners to construct their own visual images and connect those images with verbal explanations.

Signaling Principle. The signaling principle entails a final suggestion to improve the narrated animation. This principle promises deeper learning when key steps in narration are signaled rather than non-signaled. Signaling can be done by highlighting or outlining the key words or by voice annotation, such as speaking the headings in a deeper voice or speaking the highlighted words in louder voice. Signaling includes indicating section headings and summary paragraphs as well as pointing to certain important words. Signaling aims to focus the learner on key elements. It also provides clues to learners about what material to select and how to organize the material in a coherent structure. It helps learners construct mental images based on key ideas.

Students who were engaged in multimedia learning outperformed the students who learned through a traditional approach with a single mode (Charles & Lemke, 2008), but Charles and Lemke (2008) also cautioned that efficacy, motivation, volition (Deimann & Keller, 2006), learning tasks, and scaffolding could heavily impact the learning outcomes of multimedia.

Mathematics Anxiety and Attitude towards Mathematics

Mathematics Anxiety

Mathematics anxiety is a widespread problem; it is very common to hear people say, “I am not a math person” or “Math makes me nervous” (Kiss & Vukovic, 2017). Dowker, Sarkar, and Looic (2016) reported that, based on numerous studies, anywhere from 2% to 68% of students have mathematics anxiety. The reasons for this wide range include sample size, criteria, and measures used to identify the level of anxiety.

Mathematics anxiety is an emotional state of an individual in which s/he feels uncomfortable, uneasy, frustrated, and helpless while solving mathematics problems. It overloads the working memory while doing mathematics (Dowker, Sarkar & Looi, 2016; Yenilez, Girginer & Uzun, 2007), which hinders the learning process.

Richardson and Suinn (1972) defined mathematics anxiety as “the feeling of tension and anxiety that interferes with manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations” (p. 551). Tobias and Weissbrod (1980) have included a cognitive aspect and described mathematics anxiety as "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p. 65). William (1988) has given a concise definition of mathematics anxiety as "both emotional and a cognitive dread of mathematics" (p. 96).

Mathematics anxiety and gender differences are currently popular subjects of research. Studies show that females tend to express more anxiety than men and also rate themselves lower in mathematics ability than men do, even though statistically there is no significant difference in their actual mathematical performance (Beilock, Gunderson, Ramirez, & Levine, 2010; Devine, Fawcett, Szűcs, & Dowker, 2012; Dowker, Bennett, Smith, 2012; Else-Quest, Hyde, Linn, 2010; Hembree, 1990; Spelke, 2005; Wigfield & Meece, 1988). A study by Yenilmex, Girginer, & Uzum (2007) did not show any relationship between levels of mathematics anxiety and gender. However, anxiety adds to negative stereotypes or vice versa (Tobias & Weissbrod, 1980; Yenilmez, Girginer & Uzum, 2007). Walton and Cohen (2003) stated that women and minorities suffered the most from a negative stereotype concerning mathematical ability. Gautreau, Brye, and Lunceford (2016) noted that negative stereotypes are one of the prevalent factors that influence mathematics anxiety and attitude.

Attitude towards Mathematics

Attitude plays a crucial role in learning mathematics. Eshun (2004) has defined an attitude towards mathematics as "a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but which could be changed" (p. 2). Attitude towards mathematics can be measured by "liking or disliking of mathematics, a tendency to engage in or avoid mathematical activity, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (Neale, 1969; p. 632). Attitudes towards mathematics can be changed over time, and researchers have identified the three factors that influence student attitude the most. The factors are home (for example: parental expectation as well as parents' knowledge and experience with mathematics), school (teachers' beliefs and attitudes towards mathematics, teachers' knowledge, and teaching materials), and the students themselves (for example: self-efficacy, self-rating, confidence, motivation, value, and belief) (Farooq & Shah, 2008; Mata, Monteiro, & Peixoto, 2012). According to Ren, Green, and Smith (2016), an individual's attitude towards mathematics is a broad construct, including more than three essential components: confidence, motivation, and anxiety. Ren, Green, and Smith (2016) also indicated that it is difficult to distinguish between attitudes, beliefs, and emotions; attitude overlaps with beliefs, emotions, and values.

Relation between Mathematics Anxiety and Attitude toward Mathematics

Attitude and anxiety are not the same but do influence each other. Attitude is based on motivational factors (like-dislike, good-bad) whereas anxiety is based on emotional factors (fear, frustration, tension) (Dowker, Sarkar, & Looi, 2016; Richardson & Suinn, 1972; Tobias & Weissbrod, 1980; William, 1998; Yenilez, Girginer, & Uzun, 2007;). Attitude affects how one approaches learning, whereas mathematics anxiety interrupts learning (Kiss & Vukovis, 2017).

Some researchers (Ashcraft, 2002; Hembree, 1990; Maloney & Beilock, 2012) have found that extremely negative attitudes turn out to be related to mathematics anxiety, whereas Gautreau, Brye, and Lunceford (2016) suggest that feelings of anxiety about mathematics lead to a negative attitude towards mathematics. Ren, Green, and

Smith (2016) also reported that anxiety (fear and worries) hinders an individual's thinking and reasoning process, which weakens self-confidence (attitude). Gautreau, Brye, and Lunceford (2016) reported that performance pressure, negative stereotypes, and prior learning experiences are the factors that influence mathematics anxiety and attitudes. Their research has also recommended that anxiety towards mathematics should be reduced to improve attitudes towards mathematics, and this can be encouraged by hands-on learning and a problem-solving approach in which students work in groups to construct knowledge.

On the other hand, Kiss and Vukovis (2017) reported that positive attitudes reduce mathematics anxiety and its negative effects, and that negative attitudes towards mathematics develop before mathematics anxiety; therefore, attitude towards mathematics is an early indicator of future mathematics anxiety. Karadeniz and Karadag (2014) conducted a study to determine the relationship between mathematics anxiety and attitude of secondary students in a rural area of Turkey during the 2012-203 school year. The Mathematics Anxiety Scale and Mathematics Attitude Scale were used to collect data from 726 secondary school students. The study offered two significant results: mathematics anxiety was negatively correlated with mathematics attitude, and mathematics anxiety ratings explained 26% of the mathematics attitude scores.

Related Studies

This study is similar to Carleen Allison's (2015) "The Use of Instructional Videos in K-12 Classrooms: A Mixed-Method Study," and Sharp's (2002) "Understanding Relationships among Fraction, Decimal, and Percent Concepts."

Allison focused on the use of instructional videos in the K-12 classroom. The current research focuses on the use of instructional video as well, but in a different setting: the community college developmental mathematics classroom. Allison studied how often and how instructional videos are used by teachers in K-12, and I studied the impact of instructional videos on student performance and attitude towards mathematics. Additionally, Allison focused on design characteristics of instructional video and used the cognitive theory of multimedia learning (Mayer, 2001; Mayer & Moreno, 2003) to determine the effectiveness of the video in her classrooms. Similarly, the current study used the eight design principles given by Mayer (2001), which are based on cognitive theory of multimedia learning. I used the principles to select the instructional videos to use in the classroom. Allison collected data from K-12 teachers. The current study is more specific than Allison's as it focuses on the use of instructional video in only the developmental mathematics classroom.

Sharp's (2002) study is similar to the current study in regard to focusing on understanding of fraction, decimal, and percent as well as teaching through the use of problems in the context of real-life situations. The current study not only used real-life situation activities but also instructional videos to teach fraction, decimal, and percent concepts. Both studies selected rational number concepts and pointed out that national and international studies show that students are lacking in fraction, decimal, and percent concepts.

Sharp conducted his study in a suburban southern California middle school 7^{th} grade honors pre-algebra class. My study took place in a developmental mathematics classroom of an urban Connecticut community college.

Sharp conducted an attitude survey to determine students' feeling about mathematics in general and, in particular, toward the use of problems in a real-life context. The current study used an attitude survey (the anxiety sub-section of Fennama Sherman's attitude scale) and interviewed students to determine the impact of using instructional video and real-life situation activities. Sharp was unclear about the nature or source of his attitude survey.

Sharp found that experimental group showed increase in achievement, and the results of his attitude survey indicated that working with real-life situation activities changed students' attitudes. They started appreciating the value, importance, and practical uses of fraction, decimal, and percent concepts. Statistically there was no significant change in students' attitudes, but their self-confidence improved. Students had positive attitudes toward instructional videos and real-life activities. Instructional videos and activities appeared to help them understand the concepts, and, most importantly, they could see that classroom mathematics is related to real-life activities.

Chapter III

METHODOLOGY

This study examines changes in students' mathematical achievement and attitude with regard to the use of mathematics instructional videos and real-life mathematics activity assisted instruction. The source of quantitative data was attitude and test scores. Student attitude was measured through pre- and post-surveys, and student achievement by pre- and post-test scores. I interviewed students to collect additional related information.

Setting

The study was conducted at a Connecticut urban community college enrolling more than 6000 full- and part-time undergraduates. The college is accredited by the New England Association of Schools and Colleges, and many of its programs are accredited by national professional associations. The college focuses on a "hands-on" and a "put education to work" approach to learning. Most classrooms are equipped with the latest available technology. The student body of the college is diverse in age, gender, culture, religious belief, ethnicity, socio-economic status, and background. Student ages range from 15 to 90 years. The college recognizes and values diversity; its students have come from more than 60 countries and speak close to 30 languages.

The college's Mathematics Department is aligned with the college's mission by focusing on providing excellent, innovative, and affordable education to its diverse population by building a strong connection between students and community through social, cultural and other recreational activities and by supporting the economic growth of the community. The Mathematics Department offers a wide range of courses and placement into courses is determined by ACCUPLACER placement test scores. The Mathematics Department offers tutoring sessions to help students succeed.

Participants

This study focused on the students enrolled in a transitional mathematics course at the college. Such students generally have an 8th grade or lower mathematics skill level, struggle to complete college, and need remedial education for more than six months.

The sample selection process was non-random. Students who were 18 years of age and older and who enrolled in the transitional mathematics course in the spring of 2016 or in one summer 2016 section voluntarily participated in the study. Group assignments are summarized in Table 3.1. The first session offered in spring 2016 was designated a dVpA (Decimal Video and Percent Activity) group and the subsequent three sessions (2 sessions offered in Spring 2016 and 1 session offered in Summer 2016) were designated as dpfAV (Decimal, Percent, Fraction Activity and Video) groups and further referred to as dbfAV1, dpfAV2, and dpfAV3, respectively.

Table 3.1
Group Assignment and Details

Semester	**5-week session dates**	**Day/Time of Class**	**Group Type**	**Teacher A/B**	**Lesson Conducted by**
Spring 2016	1/21/16 – 2/23/16	T/R 12:00-2:20 PM	dVpA	A (Erin)	Teacher A (Erin)
Spring 2016	2/25/16 – 4/5/16	T/R 12:00-2:20 PM	dpfAV1	A (Erin)	Researcher
Spring 2016	4/7/16 – 5/10/16	T/R 12:00-2:20 PM	dpfAV2	A (Erin)	Researcher
Summer 2016	6/21/16 – 7/ 21/16	T/R 6:00- 8:20 PM	dpfAV3	B (Rich)	Researcher

For all three sessions of the dpfAV groups (dpfAV1, dpfAV2, and dpfAV3), students were working and attending classes at the community college. The dpfAV 1 and the dpfAV 2 groups were similar in gender and the time elapsed since the last mathematics course. Both groups had more females than males and had a greater number of students who had taken a mathematics course in the past year. On the other hand, the dpfAV 2 and dpfAV 3 groups were similar in terms of their first language: 50% of the students listed English as their native language. All three groups differed in ethnicity. The dVpA group and the dpfAV1 and dpfAV2 groups were taught by teacher A (we will call her Erin) on every Tuesday and Thursday from 12:00 to 2:00 pm. for five weeks. The dpfAV3 group was taught by Teacher B (we will call him Rich) on every Tuesday and Thursday from 6:00 to 8:20 pm for five weeks. Erin is a female originally from Eurasia and has been teaching in the United States for at least 3 years. Rich, an American-born male, has been teaching for 32 years. 15 students from the the dVpA group and 28 students from the dpfAV group volunteered to participate in the study, for a total of 43 participants.

Institutional Approval and Documentation

The Institutional Review Board (IRB) approval was obtained from Teachers College, Columbia University as well as from the community college where the study was conducted. Each participant signed the consent and rights form before implementation of the study. (See Appendix E for approval documents.)

Lessons

This research focuses on fractions, decimals, and percentages. Three lessons for each sub-domain with instructional video and real-life activity were designed for implementation in dVpA groups as shown in Table 1.1. Research tells us that the decimal system is “extremely powerful” and “fractions set a foundation for decimals” (Behr, Lesh, Post & Silver, 1983; Brown & Quinn, 2007; Lortie-Forgues, Tian & Siegler, 2015; Milford, 2008). Both concepts, decimals and fractions, are challenging to teach and both are foundational for advanced mathematics courses (Milford, 2008).

The three lessons, decimal place value, calculating the percentage of a whole number, and adding fractions with unlike denominators, were designed by the researcher. Each lesson included a real-life activity and an instructional video. Students were encouraged to work in groups of two or three but were allowed to work individually if they preferred.

The lesson on decimal place value included an activity in which gas prices were discussed. Students were asked if they had ever noticed the tiny little 9 at the top right corner of the gas price and, if so, to explain the significance of tenths, hundredths and thousandths decimal places.

For the percentage lesson activity, students were given a Bed Bath and Beyond shopping booklet, a 20% off coupon and $5 off on $15 coupon. Students were asked to select an item to buy and had to decide which coupon would save them more money. (Students were asked to round up the item cost to the nearest whole number to avoid tedious calculations.)

The activity for fractions was adapted from the CMP, or Connected Mathematics Program, (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997). The program was founded by the National Science Foundation to enrich the middle school mathematics curriculum. It offers a problem-centered curriculum and promotes inquiry-based teaching and learning. The activity used to teach adding fractions with unlike denominators is called the "Land Section Problem." (See appendix E for the text of the Land Section Problem.) A large square piece of land is to be shared among several farmers. Students are asked to find the fraction each farmer owns.

Instructional Videos

Some research evidence suggests that videos are the most powerful medium of learning (Betrancourt, 2005; Girod, Bell, & Mishra, 2007), so in this study each lesson included an instructional video. Instructional video includes verbal, visual, and musical aspects. The following three instructional videos related to the lesson were played in class for students to watch, and the links were shared with students in case they wished to watch outside the classroom.

- Decimals https://www.youtube.com/watch?v=qQ4YaNkA7_4 (until 4:21 minutes only)
- Percentages https://www.youtube.com/watch?v=ZBOBfZT562c (until 3:04 minutes only)
- Fractions https://learnzillion.com/lesson_plans/6861-add-fractions-with-unlike-denominators-by-creating-area-models

The criteria for selecting instructional videos were based on the eight design principles identified by Richard Mayer through his extensive research on instructional videos. Two of the three meet all of Mayer's criteria. The one exception was the decimal instructional video; it fails the coherence criterion because of extraneous sound, but was selected for lack of a better one.

Data Collection and Analysis

The source of this study's quantitative data was student achievement, survey, and a mathematics attitude scale.

Achievement

This study includes dpfAV and dVpA groups and used pre-test and a post-test to measure student achievement, each test consisting of five questions yielding a total of 10 points. The questions are based on three concepts: adding fractions, decimal place value, and computing percent of a whole number. These three concepts were part of the regular curriculum for the course. Table 3.2 shows the question categories and their corresponding points.

Table 3.2
Pre- and Post-Test Questions, Categories, and Points

Q. #	Pre-Test questions categories	Post-Test questions categories	Points
1.	Adding Fraction	Add Fraction	2 pts
2	Decimal Place Value	Decimal Place Value	1 pt
3	Computing Percent	Computing Percent	2 pts
4	Word problem on percent	Word problem on percent	3pts
5	Word problem on fraction	Word problem on fraction	2 pts
		Total Test Points	10 pts

The student achievement measure was based on pre- and post-test scores. The test questions assessed knowledge, comprehension, and application of each mathematical concept. (See Appendix A for the pre- and post-test.) The post-test is a dependent variable; pre-test, gender, age, duration of stay in the United States, first (primary) language, time elapsed since the last mathematics class, and work status are independent variables.

The Statistical Package for the Social Science (SPSS) software was used for statistical analysis. Regression analysis and an independent t-test were performed on pre- and post-test scores to measure the mathematical achievement of the dVpA and the dpfAV group. Correlation analysis was done to identify any significant correlations among variables. A regression analysis was also performed to identify any significant predictor of student's post-test scores (dependent variable) as well as the characteristics of students who showed improvement. The independent variables in this research were gender, age, time elapsed since the last mathematics class, job, and the number of years students have been living in the United States.

Attitude

In this study, the Attitude towards Mathematics Inventory (Tapia, 1996) and Mathematics Self-Efficacy Survey (Betz & Hackett, 1989) were used as models for creating the survey questions concerning attitude towards mathematics. (See Appendix B for the surveys.) Demographic variables were also analyzed to better understand students' pre- and post-attitudes towards mathematics.

The reliability and validity of the surveys were established through pilot testing and the use of Cronbach's alpha. Cronbach's alpha for the pre- and post-attitude questions was 0.782 and 0.776, respectively. The pre-survey contains 20 questions: 9 collected demographic information, 6 asked about confidence in mathematics (especially in adding fractions, decimal place value, and calculating percent), and the last 5 questions sought student opinions about learning mathematics through instructional videos and real-life activities. The post-survey contains 21 questions, 9 concerning demographic information, 4 about mathematical confidence, 4 questions concerning learning mathematics through real-life activities, and 4 questions seeking opinions about learning fractions, decimal place value, and calculating the percent of a whole number through instructional videos.

Apart from the survey I also used the Fennema Sherman mathematics attitudes scales as a source for 12 questions on anxiety in mathematics learning scale. Both the survey and the attitude scale were scored on a scale of 1-5, 1 being strongly disagree for positive questions and 1 being strongly agree for negative questions.

The mean (S.D) for the pre- and post-survey was calculated and compared between and within the dVpA and dpfAV groups. An ANOVA test was performed to see if there was any significant difference in the mean survey scores.

Interviews were conducted with a focus group of students to provide additional contextual information. I designed the 15 interview questions. The first 2 questions were designed to uncover experience with mathematics in general. The next 6 questions were designed to investigate student beliefs about using real-life activities in the transitional mathematics course. The next 6 questions were designed to elicit student beliefs about using instructional videos in the transitional mathematics course. I ended the questionnaire by allowing the interviewees to ask any questions they had regarding the study. In all, 10 students, 7 from the dpfAV group and 3 from the dVpA group, volunteered for an interview. All interviews took place on campus at a time given by the interviewee. I audio taped the interview for note-taking purposes. I carefully reviewed and synthesized the interview transcripts. During the focused analysis of the interview responses, I developed major themes based on the purpose of this study and then categorized the interview responses using the coding chart shown below (Table 3.3).

Table 3.3
Code used for analyzing the interviews

Code	**Meaning**
AttM	Attitude towards Mathematics
AttRA	Attitude towards Real-life Mathematics Activities
RAM	Real-life Activities and Mathematics learning
RAT	Real life Activities and future Transitional course
RAS	Real-life Activities and Suggestions to improve
AttIV	Attitude towards mathematics Instructional Videos
IVM	Instructional Video and Mathematics learning
IVT	Instructional Videos in future Transitional course
IVS	Instructional Video and Suggestions to improve

Chapter IV

RESULTS

The first research question seeks to understand how decimal, percent, fraction activities and the use of videos play out in an actual classroom setting. The discussion here describes in some detail the different groups involved in the study and the experiences they went through in their respective classrooms. Research questions two, three and four compares and examine the effects of instructional videos and real-life mathematics activities on student achievement and attitude in the different groups.

Research Q1

What are the experiences of students participating in two different instructional interventions related to decimal, percent and fraction concepts?

Decimal Video and Percent Activity (dVpA) Group

On the first day I reached the classroom about 10 minutes early. The class was in a computer laboratory, and I settled myself in the back corner of the room. The few students already in the class were either on their phones or on computers; many students were still walking in. The teacher waited until 12:05 and then took the attendance and passed out the syllabus. She spent a good amount of time explaining her expectations. She discussed how to organize and file all the classwork and homework; she also talked about break time (one person at a time for a bathroom break or water break), the prohibiting of cell phones, focusing in class, participation in class, and that while there is no grading of homework, students are expected to do it for practice. After discussing her expectations, she provided usernames so students could sign up with Khan Academy for the course. The teacher explained that Khan Academy was only for practicing concepts at home. The Khan Academy sign up took almost the whole class time; some students had passwords with them, some had passwords in their email, and some had not yet signed up for the course so needed information was unavailable. Much of the class period was devoted to talking about the course syllabus and trying to sign up with Khan Academy. During the last 20 minutes or so, the teacher introduced me to the class.

I gave a brief introduction to my research study. Students appeared to pay close attention, found it interesting, and were curious to know more about it. A few of them even appreciated that I was working on a doctorate and doing research. They were excited but at same time confused; one of them even said, “I do not feel like this is a regular transitional mathematics class.” Though they appeared to have many questions about my research, for some reason they did not ask them all. All the students, except one, volunteered to participate in the study. They signed the participant’s rights form, the observation consent form and the interview consent form. On the same day they also took a pre-survey and pre-test.

Pre-Survey of the dVpA Group

Demographic data were collected through the pre-survey. Table 4.1 shows demographic information related to gender, age, ethnicity, first language, stay in USA, work status, hours of work, and time elapsed since the last mathematics class. The class size was 15 students, 7 males and 8 females. It was a quite balanced class in terms of gender. In terms of ethnicity, close to 50% of students were Hispanic. Only 40% of the students’ first language was English. Though English was not the first language for many, the students have been in the United States for a long time, so they speak fluent

English. Many (about 70%) of the students were working while taking this transitional mathematics course. Only 40% of the students had taken any other mathematics classes during the past year.

Table 4.1
Demographics of Students in dvpA Group (n=15)

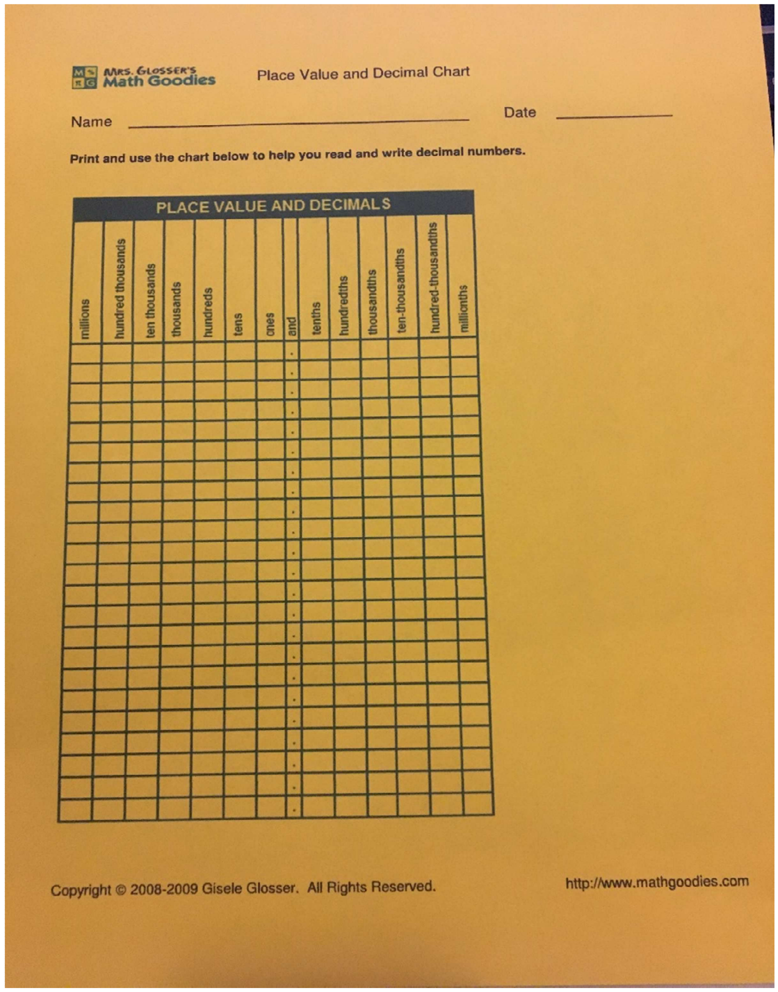
	Response %	Total Response
Gender		
Male	47%	7
Female	53%	8
Ethnicity		
African American	13%	2
Asian	0%	0
Hispanic	47%	7
White	13%	2
Other	7%	1
Unknown	13%	2
Combined/mixed	7%	1
English as a first Language		
Yes	40%	6
No	47%	7
Unknown	13%	2
Do you work?		
Yes	67%	10
No	20%	3
Unknown	13%	2
Hours of work per week		
1-20 hrs	33%	5
21-40 hrs	27%	4
Over 40 hrs	7%	1
Time elapsed since the last math class		
≤ 1 year	40%	6
2 years	7%	1
3-5 years	7%	1
> 5 years	33%	5
Unknown	13%	2

Lesson Plans for dVpA Group

This research focused on fractions, decimals, and percentages. The three lessons, decimal place value, calculating the percentage of a whole number, and adding fractions with unlike denominators, were designed by the researcher. Each lesson included a real-life activity and an instructional video. Students were encouraged to work in groups of two or three but were allowed to work individually if they preferred.

The decimal video and percent activity (dVpA) group watched only the video (no real-life mathematics activity) for the decimal concepts, received only real-life mathematics activities (no video) for the percent concepts, and was exposed to neither instructional video nor real-life mathematics activities for the fraction concepts. This way I hoped to compare and analyze the impact of video and real-life activity alone and together.

Decimal lesson (video only). During the second class of the course, students were expected to learn decimal place value, so I was there for the observation. The day before the lesson I emailed Erin (Teacher A) the link to the instructional video along with the guidelines and the decimal place value chart sheet (Fig 4.1). (The video link is https://www.youtube.com/watch?v=qQ4YaNkA7_4, a link shared with students in case they wished to watch outside the classroom. Students also received the decimal place value chart sheet.) Students were allowed to use the chart at any time, during the video, after the video, for homework, or for examinations.


Mrs. Glosser's Math Goodies

Place Value and Decimal Chart

Name ______________________ Date __________

Print and use the chart below to help you read and write decimal numbers.

PLACE VALUE AND DECIMALS													
millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones	and	tenths	hundredths	thousandths	ten-thousandths	hundred-thousandths	millionths

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http://www.mathgoodies.com

Figure 4.1. Decimal Place Value Chart

In my guidelines to Erin, I mentioned that the video lasts 5:31 minutes but that she should stop at 4:22 minutes. I asked Erin to place emphasis on two places on the video. The first point was at 1:01 minutes when the narrator says, “Decimal places mirror whole number places across the ones.” I also asked the teacher to remind students that the one’s place is located immediately to the left of decimal point. (We would later be discussing the decimal place values located to the right of decimal point. I would emphasize to students that the numeral located immediately to the right of the decimal point represents tenths.) The second emphasis point occurs at 1:14 minutes when the narrator remarks, “Notice the ‘th’ at the end of each decimal place name.” I asked Erin to remind students that if they spell the decimal place value without "th" it will be incorrect. I let the teacher decide whether she wanted to talk about these things during or after video.

I was in class as an observer and a researcher. At the start of class, Erin had about 5 arithmetic questions on the bottom right corner of the white board. The heading of these problems read "Bell Work," which meant that students were to do the problems immediately as a warm-up. Erin asked students to work on the problems, and, as students were walking in, she asked them to get settled and work on the bell work. Right after the bell work, at about 12:06 pm, Erin handed out the place value chart and played the video. About 40 seconds later one student walked into the classroom. I believe that he had no idea what was going on, but everything (class, teacher, and students) continued without paying him any attention.

Overall, Erin followed my guidelines very well. All the students watched the video with what appeared to be complete attention, all eyes were up on screen. After the video Erin asked if students had any questions or comments, but no one said anything. It was unclear to me whether they were just reluctant to ask or that they did not care much. After the video finished, the teacher began the regular instruction of place value and other concepts planned for that day.

During the observation, I was tempted to help students; I felt it would have been helpful if the transitional mathematics class could have had an assistant teacher.

Percent lesson (activity only). The percent real-life activity was the only activity conducted in the dVpA group. For the activity students were given a Bed Bath and Beyond shopping booklet, a 20% off coupon, and a $5 off on $15 coupon. Students were asked to select an item to buy and had to decide which coupon would save them more money. (Students were asked to round up the item cost to the nearest whole number to avoid heavier calculations.) The class started at 12:00 pm; the teacher went over homework as students had difficulty in changing percentages to decimals. One student requested an interpretation of 6.6%. In the teacher's words, "percent means over 100," so she wrote that 6.6% equals 6.6/100 and then asked students to move the decimal two places left in numerator and denominator to get the answer. Students practiced a few more examples of changing percentages to decimals, starting with 21%, 265.34%, and 2½%. Later, the class worked on simplifying decimal numerals divided by whole number, as students found it a difficult concept. The examples were 3.6297 ÷9, 0.801 ÷0.9, 1.152 ÷1.92.

At 12:41 pm Erin started to distribute the Bed Bath and Beyond booklet and coupons; it was the start of section of the lesson that involved my research. The teacher provided the entire class with instructions for the activity involving the booklet and coupons, but students were still not sure what they were expected to do. Their faces looked blank or questioning, but somehow, based on their understanding and a little bit of teacher help, everybody managed to finish the activity. Right after the activity, students got a break of about ten minutes. After the break the teacher talked about an algorithm for calculating percent of a whole number. As an observer, I felt that the break between the lesson and focusing on the algorithm defeated the purpose of connecting classroom mathematics with real-life activities.

Student Achievement (dVpA Group)

This study used a pre- test and a post-test to measure student achievement, each test consisting of five questions which total 10 points. The questions are based on three concepts: adding fractions, decimal place value, and computing percent of a whole number. Table 4.2 shows the mean (SD) 1.30 (2.00) of the pre-test scores of the dVpA group. The average score of 1.30 out of 10 points is very low. The post-test mean (SD) score 1.80 (2.02) did improve but not significantly, which seems understandable as they watched only instructional videos for the decimal place value lessons and worked on only one real-life activity (involving percent) but for neither concept did they receive a comprehensive lesson (instruction, video, and activity) as the dpfAV groups did.

Table 4.2

Pre and Post-Test Means (Standard Deviations) of the dVpA Group

	n	M	SD
Pre-Test	15	1.30	2.00
Post-Test	15	1.80	2.02

Maximum Test Score 10

Interview Responses Related to the Percent Activity

I interviewed 3 out of 15 students from the dVpA group and all 3 students said "yes," the activities helped them to understand the concept, which echoes many research studies that relating developmental mathematics to real life improves learning (Alexander, 2013; Armington, 2002; Bonham & Boylan, 2011; Boylan & Saxon, 2006; Byrk & Treisman, 2010; Cafarella, 2013; Galbraith & Jones, 2006; Kishawi, 2015; McMillan, Parke, & Lanning, 1997; Merseth, 2011;) and understanding of the concept (Alexander, 2013). During the interview I asked them to calculate the percent of a whole number but 2 out of 3 were unable to calculate without my help. For instance, I asked a student to calculate 10% of 15 and student said, “Basically its 15, 10 divided by 100 or 100 by 10 because it is out of 10; oh, I mean out of 100,” but then I prompted her and she was able to calculate correctly. It made me question if students really understood the mathematical aspects of the real-life activity I presented in class; however, students recommended using real-life activities in future transitional mathematics courses. Also, two students provided suggestions for improving the activities. One dVpA group student suggested making the percent activity more challenging by using coupons of 17% rather than 15%. Another suggested that the teacher should teach the concept first and then should do an activity for a practice problem.

Interview Responses Related to Decimal Video

All the students I interviewed in the dVpA group had a negative feeling toward mathematics. The following are their responses to my question “What comes to your mind when you hear mathematics?”.

> I just don’t like it. It’s not my best subject. I don’t think I am good at it.
>
> Something that feels like never need to know so that gets me, not upset but there is no point of it. We learn something that we never use in the outside world, something not everything.
>
> Pressure. It has to be right all the time. Number has to be correct, it can’t be close, so you are always putting more pressure into yourself rather than just taking steps back and just try your best and see where your weakness is. That’s one big mistake I always did as a kid trying to do right all the time and being so anxious and not getting the whole thing. It is like over thinking.
>
> When I hear math I feel ‘oh my God’ I just don’t feel comfortable because I didn’t have that consistency that practices as a child as a young person. I managed to high school but it has been a struggle so it’s a fear, fear of failing, fear failure.

These responses were more disheartening than shocking. These responses reveal that students do not see a connection between classroom mathematics and real-world mathematics. The responses also suggest that students do not have positive attitudes toward mathematics; perhaps our education system still has a lot of work to do if it is to help such students see the worth of mathematics and its connection with the world outside school. Integrating instructional videos and real-life activities with traditional teaching methods might be one way to focus attention, motivation, and enthusiasm toward mathematics. All the students interviewed not only appreciated the video-integrated lesson but also watched videos outside the classroom. They searched for them online for concepts they need help with. Here is what they said:

> I use Math Antics on YouTube. Actually, I did it before this class to refresh. Now I am using Khan Academy (KA). I don't think KA is as clear, Math Antics is very very clear and simple makes easy for me. KA is not as easy to follow. Math Antics have worksheets too.
>
> I have watched Khan Academy videos at home. They give you videos after you get the answers wrong or right. I have some of it mostly videos on steps how to get the answers sometimes if I struggling mostly. I remember in high school on fraction I didn't even understand.
>
> Absolutely, [I watch videos] anytime that I had a problem whether it was finding a place value or quotients what is this means, I will always. Usually I Google it sometimes or go on YouTube and ask for specific problem I need.
>
> Though the dVpA group watched only the decimal instructional video, they found it helpful and suggested showing more videos. One student said, "I recommend having different videos for different sections"; another said, "I would probably say [play video] between every class or every other class at least 30 min per session in a class teacher should pop up a video." Another student said "Do about 3 videos, rather than just one video.

Their feedback suggests the need for a consistent pattern of video use as well as the use of videos that integrate well with class lessons or activities. Students also appreciated the visual aspect and the different approach to teaching and learning that video brings to class:

> I think it definitely affects more and more so with students including myself as I am a visual learner. Sometimes you can tell me same thing 300 times but if I actually see it in person and knowing the rule and value of it and where it goes I will get it. I am gonna remember.
>
> Different techniques other people use because in math not only one way to solve a problem so other people have other ways so that might be a different way that teacher doesn't show so that helps you. And then just sometimes watching video is better because writing all day is boring so that also for 2 hours class just a writing gets boring and watching video once in a while is better to stay more focused. Sometimes video is good to start the assignment. If you give assignment, assignment, assignment, that doesn't work, that's not for me.

The interview suggests that students were not happy with the existing teaching approach in the transitional mathematics class; there was too much drill work. Many research studies have argued that remedial mathematics classes are not successful and that we educators are not serving these remedial students well, and the interview responses here reflect that viewpoint. This course was 5 weeks long and took place twice a week, so there were 10 classes. The 10^{th} day was devoted to the final examination, so technically students get only 9 classes focused on learning. Each class was 2 hours 20 minutes long. Teachers may give a break of 5-10 minutes if needed. Of course, time was a big concern, so the teacher frequently rushed and gave lots of worksheets for homework along with their answer sheets. Researchers have also found that low- achieving students require considerable time, much longer than 2 to 3 months, to grasp rational number concepts, so it would be unusual for them to do so in 10 classes over a 5 weeks period. Working on worksheets all the time does get tedious and students do become demotivated. To keep the students' interest, many research studies promote active learning and faculty use of a variety of instructional strategies (AMATYC, 2006).

All the students suggested showing videos in future transitional mathematics classes. A typical student said, “Some people learn visually. If you are visual learner it helps you more.” Another commented, “[Videos are a] lot more effective. People generally pays attention more because any time there is media going on; there is television on you, you want to see it so it interests you more.” Research also found that videos engage both left and right brains (Berk, 2009).

Attitude Survey (dVpA Group)

The students completed an attitude survey on the first and the last day of the class. The pre- and post-survey consisted of 8 questions related to students’ mathematical attitudes, to which participants responded on a Likert-type scale ranging from “1- Strongly Disagree” to “5- Strongly Agree” for positive questions and “5- Strongly Disagree” to 1- Strongly Agree” for negative questions. The scores of the scale were aggregated and the mean attitude score was calculated. Table 4.3 shows that the mean (S.D.) of the post attitude survey of the dVpA group is 25.73 (4.65).

Table 4.3
Pre and Post Attitude Survey Means (Standard Deviation) of the dVpA Group

	Pre	Post
n	11	14
Mean	24.00	25.73
SD	2.75	4.65

In order to understand the attitude of the dVpA group students towards mathematics, a few survey questions were analyzed, and the percentage of agree and strongly agree responses to those questions are displayed in Table 4.4. At the beginning of the course only 7% of the students were confident in their mathematical abilities but by the end of the course about 18% of students expressed self-confidence in mathematics. Also, the percentage of students who could calculate 15% of a given amount went up from 14% to 64%. In the pre-survey 79% of the respondents either agreed or strongly agreed that real-life mathematics activities in class could help them learn mathematics with greater understanding but in the post-survey this percent went down to 73%. Also, the percentage of students who agreed or strongly agreed that real-life mathematics activities are/were boring and a waste of time went up from 50% in the pre-survey to 55% in the post-test. These results suggest that the real-life mathematics activities did not help students to develop positive attitudes towards mathematics. On the other hand, instructional videos did seem to help students develop positive attitudes; Berk (2009) also listed "videos improve attitude towards content and learning" as one of the 20 values of using videos. Based on the survey, students who consider that online mathematics instructional videos take away instruction time and do not help them decreased from 57% to 36%. Given the uncertain reliability of the informal attitude survey, the results here should be taken as suggestive only.

Table 4.4
Agree or Strongly Agree Responses to Eight Survey Questions: dVpA Group - Pre- versus Post-Survey

Survey Question	dVpA Pre (agree and Strongly agree) (n = 11)	dVpA Post (agree and strongly agree) (n = 14)
I will/was good at solving math problems in this transitional math course	14%	45%
I have self-confidence when it comes to math	7%	18%
Studying mathematics in transitional mathematics course made me nervous	21%	55%

I can figure out how much I will save if there is a 15% discount	14%	64%
Real-life math activities in class helped me learn math with greater understanding	79%	73%
The real-life math activities are/were boring and waste of time	50%	55%
Watch online mathematics videos at home to do the homework	14%	18%
Video takes away instruction time, not helpful	57%	36%

Mathematics Attitude Scale (dVpA Group)

Apart from the survey questions, I also used 12 questions from the anxiety subscale of the Fennema Sherman Mathematics Attitude Scale. There are 6 positive and 6 negative questions, scored on a scale of 1-5, 1 representing strongly disagree for positive questions and 1 representing strongly agree for negative questions. Scores were aggregated for analysis. Participants can get a minimum score of 12, median score of 36 and a maximum score of 60. Participant scores higher than 36 indicate low anxiety, scores lower than 36 indicate high anxiety, and a score of 36 designates neutral cases. Table 4.5 shows that the percentage of students with low anxiety was 45 and the percentage of students with high anxiety was is 54.

Table 4.5
Aggregated Score of Mathematics Attitude Scale (anxiety subscale): dVpA Group Post Scale

Categories	Post Scale
Aggregated score > 36 (low anxiety)	45%
Score of 36 (neutral cases)	0%
Aggregated score < 36 (high anxiety)	54%

n = 11

Decimal, Percent, Fraction Activity, and Video (dpfAV) Group

Course Plan

There were three dpfAV groups. Like the dVpA group, these three dpfAV groups met in a computer laboratory. As did Rapp and Gittinger (1993), I questioned when and how students used the laboratory computers, and my observation was that they hardly ever used computers or any other tech devices in the classroom. On the first day of the course, I introduced the research, collected consent forms and administered the pre-survey, mathematics attitude scale, and pre-test to all the three dpfAV groups. I taught three lessons in the course. The first lesson was on decimals, the second was on percentages, and the third and final lesson was on fractions. I coordinated with the class teacher to implement these lessons. After three lessons I interviewed students to collect data on the video and activity integrated mathematics lessons. On the second to the last day of the course I administered a post-survey and mathematics attitude scale. On the last day, students took the post-test. The post-test was part of the final examination of course.

Pre-Survey of dpfAV Group

From the Pre-Survey, I learned about the classroom's demographics, which are reported in Table 4.6. The gender distribution in the class skewed towards females with 64% females and 34% males. For 46% of the students, English was not the first language. However, owing to the time spent in the United States, they had developed a decent proficiency in English, which was demonstrated by their class participation, their effortless interaction with classmates and teachers, and their performance during the interview process. 46% of the students were of Hispanic origin followed by African-

American origin at 25%, and White at 29%. About 80% of the students in the dpfAV groups were working jobs outside of the classroom, and more than 50% of the students had taken mathematics classes during the past year.

Table 4.6
Demographics of dpfAV Students

	Response %	Total Response
	Gender	
Male	36%	10
Female	64%	18
	Ethnicity	
African-American	25%	7
Asian	0%	0
Hispanic	46%	13
White	29%	8
Other	0%	0
Unknown	0%	0
Combined/mixed	0%	0
	English as a first Language	
Yes	54%	15
No	46%	13
Unknown	0%	0
	Do you work?	
Yes	82%	23
No	18%	5
Unknown	0%	0
	Hours of work	
1-20 hrs	35%	8
21-40 hrs	39%	9
Over 40 hrs	26%	6
	Time elapsed since previous math class	
≤ 1 year	54%	15
2 years	7%	2
3-5 years	7%	2
> 5 years	32%	9
Unknown	0%	0

Lesson Plan for dpfAV Group

All the lessons followed a similar pattern. The lessons would begin by asking students to recall circumstances in real life where they saw the application of a given concept. I would then discuss those circumstances and specific application of mathematics concepts. We would then narrow it down to the real-life activity that we would complete in the class.

All such exercises were set up to be group working sessions. Students worked in a group of 2 or more. Though they were encouraged to work in a group, they were allowed to work alone if they preferred. These activities ranged from identifying the decimal place value in the gas price, organizing a piece of land into parts using fractions, or calculating the best deal based on discount percentage. All activities included worksheets that the students were required to complete.

After the activities were complete, the concepts were reinforced via videos that I had selected using the eight design principles suggested by Richard Mayer and colleagues.

Decimal lesson (activity and video). The decimal lesson was my first lesson in the transitional mathematics course. When prompted, most students instantaneously responded that they saw decimals “everywhere.” Through conversation, we narrowed down that they applied decimals every day in the context of price for goods in retail stores.

We then launched into our real-life activity – identifying the gas price (decimal place value/decimal notation). I shared the gas price image shown in Figure 4.2 with the students and asked them if they had ever noticed the tiny little 9 at the top right corner of the gas price. If they had noticed, I asked them what it meant.

Figure 4.2. Gas Price Image Used for Decimal Lesson

To their own surprise, most students had never paid any attention to it. I clarified that the small 9 represents nine tenths of a penny, which is smaller than a penny—the smallest currency unit. So, although the cost of the gas is nine-tenths of a penny, we end up paying a penny.

To illustrate the significance of a decimal, I shared with them that (according to a newspaper article I read in 2007) the United States had a sale of 142 billion gallons of gasoline and by adding 9/10 of a penny the industry made an extra $1,278,000,000 (Rogers, 2009).

The above statistic got the students' attention. After that introduction, we then moved to the actual activity. The students split into groups of 2 and each group received their own image of the gas prices as illustrated in (Fig. 4.3). The students in the group discussed their knowledge and understanding of the third digit after the decimal and articulate it on poster board. Each group designated an individual to explain their group's understanding to the class. I prompted the students to think about the significance of the third digit since we write money in terms of hundredths. In the example below, what does 9 really mean in the regular gas price of $3.759 and what is the exact price of the gas?

In the debrief, most groups agreed that they had never noticed the third digit. However, most of them guessed that the third digit rounded to the hundredths place. For example, the gas price for regular gas at $3.579 would cost $35.79 for 10 gallons, but for 11 gallon it will cost $39.37 instead on $39.369. or for 9 gallons it would be 32.21 (round down) instead of 32.211.

Figure 4.3. Gas Price Image Used for Decimal Lesson

The activity and the discussion allowed the students to discuss and arrive at the significance of tenths, hundredths, and thousandths. I summarized the findings for the class, and then emphasized the “ths” to make students aware of the difference between tens and tenths and so on.

I then distributed the Place Value and Decimal Chart (Fig 1) sheet to students and encouraged them to use it for future exercises. We then moved on to watch the video. (The video link is https://youtu.be/qQ4YaNkA7_4.) I played the video only up to 4:21 minutes. It explains useful facts about decimals, (for instance, that decimal places are to the right of decimal point and that each place represents a unique fraction). The video teaches students to read the decimal with a correct decimal place name, and it uses a decimal-based measurement of real-world examples such as the length of a bug. The video culminates with a question. The students were required to use the place value chart to complete the activity.

Percent lesson (activity and video). The percent lesson followed a path similar to that of the decimal lesson. I prompted students to identify where they use percentage the most in real life. Almost all the students identified using discounts while purchasing products at a store as an example. This made it easy to transition into the activity.

For the percentage lesson activity, I repeated the Bed, Bath, and Beyond shopping booklet example from the dVpA group. Unlike the dVpA group, where the teacher implemented the activity, I played the role of the teacher for the dpfAV group.

The students were organized into groups of 2 and given Bed Bath and Beyond shopping booklets, “20% off” coupons, and “$5 off on $15 or more” coupons. The activity required the students to calculate prices of items using both coupons individually and to find out which coupon would save more money. As I introduced the activity, I mentioned to the students that, unlike at a store, students had paper and pencil. The students indicated that they would use their cell phone calculators in the real-life situation. To get their attention and to motivate them, I told them that given any price, I could easily calculate 10% of it without a calculator, paper, or pencil.

The students got excited and began to challenge me with big numbers, but I kept answering them, and they used their cell phones to validate my answer. It piqued their curiosity, so I explained how to calculate 10% mentally and explained why “moving the decimal point one place to the left” works. We then discussed how to use 10% to calculate 5% or 20% or 30% and so on. The students then completed the group activity and I debriefed the class.

In the debrief, most students calculated the percentage but forgot to calculate the discounted price by subtracting the percent from the original price. I had to constantly remind them about it. To improve this lesson in the future, I would explicitly call for this step in the instructions.

Unlike the dVpA Group, the dpfAV group also watched a video. The video shows how to mentally calculate percentages. The link is https://www.youtube.com/watch?v=ZBOBfZT562c. It starts with a chart that shows a relation between percentage, decimal, and fraction. It also reviews the basic percentages such as 10%, 1%, 100%, and 50%. Finally, the video teaches them how to calculate 5% and 15% to get a deeper understanding of the concepts. I then wrapped the lesson by asking the students to practice calculating percent as it could potentially save them some money in the future.

Fraction lesson (activity and video). The fraction lesson was the third and the last lesson in the transitional mathematics course. As in other sessions, I started out by prompting the students to identify the real-life situations in which they use fractions. Most of the students gave examples of sharing a pizza or other items among friends. We then took a step back. I asked the students "What is a fraction?" A few students drew fraction bars or pizza slices (or circle segments); some wrote phrases like "half of something," "part of a whole," "divide something," and "a portion."

After discussing, we identified a few examples such as measuring ingredients while cooking using a recipe; sharing with a friend is another area where we use fractions. We then briefly discussed the relationship between fractions, decimals, and percentages, and I explained to the class how fractions are foundations for algebra and other advanced mathematics. The students began to understand that fractions are foundational and that they manifest themselves in various ways in real life.

After the discussion, I gave them a problem involving the adding of fractions. In the pre-test, almost all of the students added the numerator and denominator directly; most of the students did the same thing in class as well. Instead of explaining why it is incorrect to add denominators. I led an activity in which students paired up to solve the "Land Section Problem." The activity for fractions was adapted from the Connected Mathematics Program (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1997). The activity teaches adding fractions with unlike denominators.

In the land section problem, students were asked to find the fraction each farmer owns and to answer three questions in which they needed to add the land sections of two farmers. First, students estimated each land section as a fraction of the total land area, but the land sections were not equal in size.

Throughout the activity, I checked frequently with each group to make sure they understood the concept of a whole and equal parts before writing the appropriate fraction for each land section. Each group took at least three trials to get to the idea of designating equal parts of a whole but once they got it, it appeared to make sense to them, and it gave them a visual image on which they could construct the idea of a common denominator.

After the activity, the class watched the video focusing on the algorithm for adding fractions with unlike denominators by creating area models. Studies have found that visual representations and knowledge of area concepts help students to grasp rational number concepts. The video begins with numerators, denominators, pictorial representations of fractions, and common denominators. The video link is https://learnzillion.com/lesson_plans/6861/lesson.

At the end, I gave the students another problem on adding fractions, and they were able to do it. Finally, I pointed out the connection between the activity and the video. Following the three lessons, I administered a post-test.

Student Achievement (dpfAV Group)

Table 4.7 shows that the pre-test mean (SD) score of the dpfAV group was 1.18 (2.05) and the post-test mean (SD) score was 4.50 (3.90). The comparison of the pre- and post- test indicates a statistically significant difference in students' performance ($t_{27} = 4.39$, $p < .001$)

Table 4.7
Mean Score of dpfAV Groups

	n	M	SD
Pre-Test	33	1.18	2.05
Post Test	28	4.43	4.06

The dpfAV group student performance was further analyzed; I found a statistically significant correlation between post-test scores and subjects having learned English as their first language ($r = -.461$, $p < .01$)

dpfAV group: post-test score vs ethnicity. The mean post-test scores of students with African American, Hispanic, and White ethnicity are displayed in Table 4.8. The mean post-test score of Hispanic students was 4.46 points higher than the mean post-test scores of White students. There was a significant difference between the mean post-test scores of Hispanic and African-American students. About 20% of variance in post-test scores is explained by difference in ethnicity; ethnicity is a significant predictor of post-test scores ($F = 3.57$, $p < .05$).

Table 4.8
Mean Post-Test Score by Ethnicity of dpfAV Group

Ethnicity	Mean	N	Std. Deviation
African American	2.94	9	3.48
Hispanic	6.54	13	3.97
White	2.08	6	3.11
Total	4.43	28	3.96

dpfAV Group: post-test score vs other variables. The other independent variables in this research were gender, age, time elapsed since the last mathematics class, job, and the number of years of living in the United States. Based on the regression analysis none of the above-mentioned variables demonstrated a significant effect on the post-test scores.

Interview response related to three activities

I interviewed 7 out of 28 students from the dpfAV group. Out of the seven students, four liked decimal and percentage based real-life activities, and three liked the fractions based real-life activity. According to the students, activities were helpful and the best part was that they could relate to these activities, which helped them see connections between classroom mathematics and real-life mathematics. Students commented that the activities would be worth continuing in future transitional mathematics courses. 5 out 7 students said the activities were “great,” “perfect,” “above average, “well-paced,” “helpful the way they were,” and “effective because they were simple and easy to understand.”

A few students provided suggestions for improving the activities. One student suggested going at a slower pace to capture the attention of more students. One of the students was not in favor of group work for the activities.

The student said,

> I do not do well in group activity, and there is absolutely no point in me sitting with someone who is as confused as I am. Working with other people is not a math thing. If I am going to screw up let me screw up on my own and then come to you and let you look at it.

Overall students found these activities a good change from what they saw as the monotonous classroom routine characterized by worksheets. A few responses from students on the real-life activities are as follows:

> I would have to say the percentage one was good. Because I shop, shop for my family and I am good at looking for good deals. I don't like spending too much money something I can get cheaper in different place. I try to be wise shopper. Be a wise shopper that's what I have always been taught growing up. Sometime it is never to be cheap while buying certain things. The whole lesson you taught would pop into my mind, then I can easily relate it.

> The fraction, land section one. It was very helpful. Helpful in terms of finding equal pieces or equal denominators.

> All [activities] were good, we learn something. It was an eye opening, when it comes to 9 tenths in gas price and basically, they are rounding up so I was like wow. When I noticed, it's like now I see it, so it was eye opening. That was good thing you brought it up.

Interview Response Related to Three Videos

Out of the 7 students in the dpfAV group, 3 liked the decimal video best, 3 liked the percent video best, and 1 student liked the fraction video best. Students had mixed attitudes toward the mathematics instructional videos. Two students had negative attitudes, saying that instructional videos were distracting and interruptive. These students also said that they would perceive instructional videos better if assigned by the professor or if they had mastered the concept so they could check the video's claims. The rest of the students had positive attitudes. According to a student, the instructional videos were good at gaining attention and helpful in learning new concepts. One student said the videos were simple, clear, and very specific to the topic. Two students found the visual aspects of instructional videos beneficial to their learning; one of them also mentioned that the combination of all three instructional videos, classroom teaching, and real-life activities are helpful in meeting the needs of all the students.

The decimal instructional video was the only video that received strong negative feedback in the dpfAV groups. According to the students, the decimal instructional video was too animated and took away the focus from learning. The video was animated in a way that the cartoon characters of a ladybug, a bird and a girl were used. The narrator spoke very slowly and used the phrases like "let's try it together" or "good job" which sound more suitable for young elementary students than the community college students. One student said that it was demeaning and interruptive to watch such an elementary level video. The decimal instructional video was the only instructional video that did not meet the instructional video selection criterion of coherence (in which extraneous sound, words, or pictures are excluded).

In regards to instructional videos and mathematics learning, 2 out of 7 students said instructional videos do make a difference in learning because of their visual aspect and clarity. One of the students said, "If something is not clear go to video." Another said, "Sometimes videos are clearer and less confusing than professor."

The use of instructional videos in future transitional mathematics courses was supported by almost all the students. Research studies and projects support the use of videos in education as well (Berk, 2009; Thornhill, Asensio, & Young, 2002). Students said that the younger generation is into technology and these days people learn through videos and computers, so their use is worth continuing in future courses. Only one student was completely against the idea of using videos in transitional mathematics courses. She said, “I believe students have to be fully engaged with professor at all times. You are in transition math for a reason. I think videos are more if you have grasp on idea, you have little more time to work on it. It is like here is the bonus feature lets watch this video.”

All students (except one) provided suggestions to improve the use of instructional videos in transitional mathematics courses. According to the responses instructional videos should be less animated, but fun and interesting, with a slower pace, and should meet the needs of different people. One student said, “It would be nice we all can get on the computer and do exercises based on those videos because it follows through on a learning and re-enforces it.”

Attitude Survey (dpfAV Group)

In order to understand the attitude of the dpfAV group students towards mathematics, eight survey questions were analyzed, and the percentage of “agree” and “strongly agree” responses to those questions are displayed in Table 4.9.

Table 4.9
Agree or Strongly Agree Responses to Eight Survey Questions dpfAV Pre- versus Post-Survey

Survey Question / n	dpfAV Group Pre (agree and Strongly agree)	dpfAV Group Post (agree and strongly agree)
n	34	28

I will be/was good at solving math problems in this transitional math course	47%	46%
I have self-confidence when it comes to math.	15%	32%
Studying mathematics in a transitional mathematics course made me nervous	29%	32%
I can figure out how much I will save if there is a 15% discount	24%	79%
Real-life math activities in class helped me learn math with greater understanding	71%	86%
The real-life math activities are/were boring and waste of time.	12%	4%
Watch online mathematics videos at home to do the homework.	32%	36%
Video takes away instruction time, not helpful	15%	21%

At the beginning of the course only 15% of the students were confident in their mathematical abilities but by the end of the course about 32% of students expressed self-confidence when it comes to mathematics. Also, the percentage of students who could calculate 15% of a given amount went up from 24% to 79%. Both 15% to 32% and 24% to 79% are more than a 100% increase, which could mean that this course does help boost student confidence in mathematics skills.

However, even though by the end of the course students had more self-confidence, they did not seem to believe they were good at solving mathematics problems in the course. The responses to the survey statement “I will/was good at solving math problems in this Transitional Math Course” were virtually unchanged, from 47% to 46%.

In the pre-survey, 71% of the respondents either agreed or strongly agreed that real-life mathematics activities in class helped them learn mathematics with greater understanding and in the post-survey this percent went up to 86%. Also, the percentage of students who agreed or strongly agreed that real-life mathematics activities are/were boring and waste of time went down from 12% in the pre- survey to 4% in the post-test; these results indicate that the real-life mathematics activities help students to develop positive attitude towards mathematics.

On the other hand, based on the survey, students who consider that online mathematics instructional videos take away instruction time and do not help them in learning mathematics went up from 15% to 21%, perhaps because of the decimal instructional video. Because of attitude questionnaire's uncertain reliability and informal nature results here should be taken as suggestive only.

Mathematics Attitude Scale (dpfAV Group)

Apart from the survey questions, I also used 12 questions from the anxiety subscale of the Fennema Sherman Mathematics Attitude Scale. There are 6 positive and 6 negative questions, scored on a scale of 1-5, 1 representing strongly disagree for positive questions and 1 representing strongly agree for negative questions. Scores were aggregated for analysis. Participants can get a minimum score of 12, median score of 36, and a maximum score of 60. Participant scores higher than 36 indicate low anxiety, scores lower than 36 indicate high anxiety, and a score of 36 designates neutral cases. Table 4.10 displays the percentage of participants with an aggregated score above 36, exactly 36, and below 36. Table 4.10 also shows that the percentage of students with low anxiety increased and the percentage of students with high anxiety decreased. The mean post-scale score is 2.44 points higher than the mean pre-scale score but statistically it is not significant.

Table 4.10
Aggregated Score of Mathematics Attitude Scale (Anxiety Subscale): dpfAV - Pre versus dpfAV - Post-Scale

	Pre	Post
N	25	25
Aggregated score > 36 (low anxiety)	20%	36%
Score of 36 (neutral cases)	8%	8%
Aggregated score < 36 (high anxiety)	72%	60%

Attitude scale (anxiety subscale) analysis by gender. The average pre- and post-scale scores were also analyzed by gender. The post-scale scores of males improved by 3.11 points but statistically there is no significant average difference between the pre- and post-scale score of males ($t_8 = -.989$. $p > .001$). The post-scale scores of females also went up by 2.06 but that is not a statistically significant difference ($t_{15} = -1.180$, $p > .001$). Research studies also show that females in general express more anxiety than men but that statistically there is no significant difference in their actual mathematics performance (Beilock et al., 2010; Devine et al., 2012; Dowker et al., 2012; Else-Quest et al., 2010; Hembree, 1990; Spelke, 2005; Wigfield & Meece, 1988).

Change in aggregate score of attitude scale. The overall analysis of pre- and post-scale scores shows that for 56% of the students the Mathematics Attitude Scale scores went up, for 36% of students' scores went down, and for 8% of students' scores were unchanged (Table 4.11). The mean post-scale scores of 14 (56%) students went up by 8 points, as shown in Table 4.12, a statistically significant change ($t_{13} = -8.23$, $p <$

.001). Table 4.13 shows that the mean post-scale score of 9 (36%) students went down by 5.67 points, which is also statistically significant ($t_8 = 3.08$, $p < .001$).

Table 4.11
Number of Students' Whose Attitude Score Changed from Pre-to Post

	N	%
Scores went up	14	56%
Score stayed the same	2	8%
Scores went down	9	36%
Total	25	100%

Table 4.12
Paired Samples Test for 14 Students Whose Post-Scale Score Improved

	Paired Differences								
					95% Confidence Interval of the Difference				
	n	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pre Atti – Post Atti	14	-8.00	3.63	.97	-10.10	-5.90	-8.23	13	.000

Table 4.13
Paired Samples Test for 9 Students Whose Post-Scale Scores Decreased

	Paired Differences								
					95% Confidence Interval of the Difference				
	n	Mean	S.D	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pre Atti –Post Atti	9	5.67	5.52	1.84	1.42	9.91	3.078	8	.015

Research Question 2.a

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematical achievement of students when compared to a traditional method?

In order to answer this research question, first I compared the post-test score of the dVpA group and that of the dpfAV group. Then, I compared the dVpA and the dpfAV group for their scores on the fraction questions in the post-test to examine the effect of instructional video and real-life activity assisted instruction versus the effect of traditional methods.

Post-Test Score Analysis: dVpA vs dpfAV Group

Before analyzing the post-test score, it was necessary to analyze the pre-test scores to determine whether the dVpA and the dpfAV groups were equivalent on the pre-test. The t-test determined whether there was a statistically significant difference between the two groups' mathematical achievement. As indicated in Table 4.14, no statistically significant difference, at $\alpha = .05$ level, was found in the pre-test of the dVpA and the dpfAV group.

Table 4.14
Mean Score Comparison for Pre-Test: dVpA vs dpfAV

dVpA Group			dpfAV Group					
n	M	SD	n	M	SD	t	df	P
15	1.300	1.998	33	1.333	2.142	-.051	1	.960

Overall, the use of instructional videos and real-life based activities does appear to make a positive impact on students' mathematical achievement. Table 4.15 and Figure 4.4 provides the results of the independent sample t-test for the post-test scores of the dVpA and the dpfAV group. Since $p < .01$, less than our chosen $\alpha = .05$, we can conclude that there is a significant difference between the mathematical achievement of students taught by instructional video and real-life mathematics activity assisted instruction and mathematical achievement of students taught with traditional methods ($t_{40.88} = -2.84$, $p < .01$). Research supports this finding; studies found that use of instructional videos and relating developmental mathematics to real-life situations as well as having students work in small groups improve learning. Research also identified that instructors of the best practice institutions use at least three different instructional strategies.

Table 4.15
Mean Score Comparison for Post-Test: dVpA vs dpfAV

dVpA Group			dpfAV Group					
n	M	SD	n	M	SD	t	Df	p
15	1.80	2.02	28	4.43	4.06	-2.84	40.88	.007

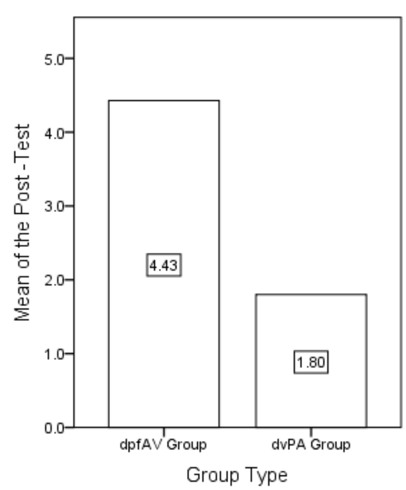


Figure 4.4 Post-Test Means of the dVpA and dpfAV Groups

The data show that the post-test mean of the dpfAV group is higher than that of the dVpA group. In order to understand the data better, I compared the mean post-test score of males and females. The analysis of the post-test mean in terms of gender shows that males outperformed females. The female post-test mean (S.D.) in the dpfAV group was 4.67 (3.89), which was higher than the 2.44 (2.32) female post-test average in the dVpA group but was not statistically significant. Similarly, the post-test mean (S.D.) of males in the dpfAV group was 4.00 (4.53), which was higher than the 1.07 (1.43) on the post-test mean of males in the dVpA group but the difference in their mean was not statistically significant.

Post-Test Score of the Fraction Question: dVpA versus dpfAV Group

The post-test included two questions on adding fractions. One of the adding fraction questions, fraction question #1, was designed to determine whether students could use the standard addition-of-fractions algorithm. Even though we cannot make too much of results involving only one question, the outcomes here are suggestive. The mean (S.D.) post-score of the dVpA group for the fraction question#1 was 0 (0) (Table 4.17), which means not a single student could perform the algorithm of adding fractions. The mean (S.D.) post-test score of the dpfAV group for the fraction question#1 was 1.21 (0.99) (Table 4.17), which was significantly greater than the mean (S.D.) post-score of the dVpA group. Table 4.17 contains a statistical comparison of the post-test means of fraction question #1. Table 4.18 shows $p < .001$, less than our chosen $\alpha = .05$, so we conclude that there is a significant difference between the post-test means of fraction question #1 for the dVpA and the dpfAV groups ($t_{27} = -6.46$, $p < .001$).

The other fraction question, a word problem involving the addition of fractions, was designed to test whether students could apply the computational skills of adding fractions to a real-life example. The post-test mean score of the fraction word problem for the dpfAV group was .84 (.96), significantly higher than the post-test mean (S.D.) score for the dVpA group .10 (.28). Both fraction question #1 and the fraction word problem question #5 show similar results: the mean scores of the dpfAV group are higher than those of the dVpA group. Based on the research study's results, students learned the procedure with conceptual understanding and therefore applied it correctly. The post-test mean score for the fraction word problem for the dpfAV group is .84 (.96), higher than the post-test mean (S.D.) score for the dVpA group .10 (.28). Table 4.17 contains a statistical comparison of post-test means of the fraction word problem. Since $p < .001$, less than our chosen $\alpha = .05$, we conclude that the post-test mean of the fraction word problem for the dpfAV and the dVpA group is significantly different ($t_{34.55} = 3.76$, $p < .001$).

The means (S.D.) of the combined scores from both fraction questions show that the dpfAV students performed better than the dVpA group. The mean (S.D.) of the dVpA group was .10 (.28) and the dpfAV group mean was 1.98 (1.85). Table 4.16 contains a sample t-test of the combined scores of the fraction questions. The dpfAV group scored higher than dVpA group on the post-test ($t_{29.252} = -5.263$, $p < .001$). Since $p < .001$, less than our chosen $\alpha = .05$, we reject the null hypothesis and conclude that there is a significant difference between the mathematical achievement of students taught by instructional video and real-life mathematics activity assisted instruction and the mathematical achievement of students taught by traditional methods. The result reflects the impact of good instruction. In Lemire's (1998) point of view good instruction includes some component of all three learning styles: visual, auditory and haptic; the dpfAV group learned the fraction concept through variety of modes: lecture, instructional video, and real-life mathematics activity.

Table 4.16
Mean Score Comparison for the Post-Test Score of the Fraction Question

	dVpA Group		dpfAV Group				
Fraction Q#	M	SD	M	SD	t	df	p
Q.1	.00	.00	1.21	.99	6.46	27.00	.000
Q.5	.10	.28	.84	.96	3.76	34.55	.000
Q.1 and Q.5	.10	.28	1.98	1.85	5.26	29.25	.000
n= 15 (dVpA Group), n= 28 (dpfAV Group)							

Research Question 2.b

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematical achievement of students when compared to supporting traditional instruction with instructional videos?

The dpfAV group was taught decimal place value using real-life activities and instructional video whereas the dVpA group was taught using only instructional video. The post-test contained one question on decimal place value. The mean (S.D.) post-scores on the decimal question are shown in Table 4.20. The mean (S.D.) post-test score of the dVpA group was 0.43(0.50) and the dpfAV group score was .41 (0.49). The mean post-test score of the dVpA group was higher than that of the dpfAV group. Table 4.20 provides the results of the independent sample test for the post-test scores on the decimal question. Since $p > .01$, greater than our chosen $\alpha = .05$, we can conclude there is no significant difference between the post-test mean of the decimal questions for the dVpA and the dpfAV group ($t_{41} = .14$, $p > .01$). Based on the results displayed in Table 4.19, we failed to reject null hypothesis and conclude that there is no significant difference, at the .05 level of confidence, between the mathematical achievements of students taught by instructional video and real-life mathematics activity assisted instruction and mathematical achievement of students taught by instructional video.

Table 4.17
Descriptive Statistics and T-Test Results for Post-Test Scores of Decimal Questions: dVpA versus dpfAV

dVpA Group			dpfAV Group					
n	M	SD	n	M	SD	T	df	p
15	.43	.50	28	.41	.49	.14	41	.89

Note: * $p > .05$ $F = .04$

Research Question 2.c

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematical achievement of students when compared to supporting traditional instruction with real-life activities?

This research question was answered through an analysis of students' correct responses to the post-test questions on calculating percent of a whole number. The dpfAV group students learned to compute percent of a whole number through instructional video and real-life assisted instruction, whereas the dVpA group learned to compute percent of a whole number using real-life assisted instruction. The post-test contained two questions (Q3 and Q4) on percent. Question 3 was designed to test computational skills involving percent. Question 4, a word problem involving computation of percent, was designed to test whether students could apply their computational skills to a real-life situation. Students received partial scores for partially correct responses. The dpfAV group received higher scores than the dVpA group in both percent questions (Q3 and 4). The combined mean and standard deviation of the post-test scores for both percent questions are displayed in Table 4.20. The combined mean (S.D.) score of the dpfAV group was 1.95 (2.26) higher than the 1.37 (2.00) mean score of the dVpA group. Based on the post-test mean, dpfAV students performed well, but Table 4.20 also shows that statistically there is no significant difference between the dVpA group and the dpfAV group (t_{41}= .202, $p > .05$). The observed differences may be due to sampling error. The statistical results show that the probability of making a type II error is 36.9%.

Table 4.18
Descriptive Statistics and T-Test Results for Post-Test Scores of Percent Questions: dVpA versus dpfAV

dVpA Group			dpfAV Group					
n	M	SD	n	M	SD	t	df	p
15	1.37	2.00	28	1.95	2.26	.202	41	.410

Note: * $p > .05$ $F = .041$

Research Question 3

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematical attitude of students?

The students completed an attitude survey on the first and the last day of the class. The pre- and post-survey consisted of 8 questions related to students' mathematical attitude, to which participants responded on a Likert-type scale ranging from "1- Strongly Disagree" to "5- Strongly Agree." Questions were scored in such a way that a higher number represented a more favorable attitude. The scores of the scale were aggregated and the mean attitude score was calculated. Cronbach's alpha for the pre- and post-attitude questions was .782 and .776, respectively. The mean (S.D.) of the post attitude survey is displayed in Table 4.21. The dpfAV group mean was 27.04 (5.20), which was higher than the dVpA group mean of (S.D.) 25.73 (4.650). The dpfAV group mean is higher but Table 4.22 shows that the mean difference is not significant ($t_{37} = .727$, $p > .05$). Since $p > .05$ we accept the null hypothesis and conclude that there is no significant difference, at the .05 level of confidence, between the mathematical attitudes of students taught by instructional video and real-life mathematics activity assisted instruction and the mathematical attitudes of students taught by traditional methods.

Table 4.19
Post Attitude Survey: dVpA vs dpfAV

Group Type	n	Mean	Std. Deviation
dVpA	11	25.73	4.65
dpfAV	28	27.04	5.20
Total	39	26.67	5.01

Table 4.20
ANOVA for Post Attitude Survey: dVpA vs dpfAV

	Sum of Squares	df	Mean Square	F	p
Regression	13.52	1	13.52	.53	.48
Residual	947.15	37	25.60		
Total	960.67	38			

Research Question 4

What are transitional mathematics course students' attitudes towards the use of instructional videos and real-life activities in their mathematics course?

Real-Life Mathematics Activities

Three activities took place in the dpfAV group classroom, one each on fractions, decimals, and percentages; only one activity (on percent) was conducted in the dVpA group. Students held a positive attitude towards learning mathematics through real-life activities. I interviewed 10 students – 7 from the dpfAV group and 3 from the dVpA group. Out of the 7 dpfAV group students, 4 liked decimal and percentage based real-life activities, and 3 liked the fractions-based real-life activity. 9 out of 10 students said that the activities helped them to understand the concept.

All 10 students believe that these activities were eye opening and should be included in future lessons in transitional mathematics courses. Students viewed the activities as a bonus, one more way to learn, and commented that people learn differently, so it would be worth continuing in future transitional mathematics courses. 7 out 10 students said the activities were “great,” “perfect,” “above average,” “well-paced,” “helpful the way they were,” and “effective because they were simple and easy to understand.”

A few students provided suggestions for improving the activities. One dVpA group student suggested making the percent activity more challenging by using coupons of 17% rather than 15%. Another student suggested going at a slower pace to capture the attention of more students. One of the students in the dpfAV group was not in favor of group work for the activities. The student said, “I do not do well in group activity and there is absolutely no point in me sitting with someone who is as confused as I am. Working with other people is not a math thing. If I am going to screw up let me screw up on my own and then come to you and let you look at it.”

Overall, students found these activities a good change from what they saw as the monotonous classroom routine of worksheets. A few responses from students to the real-life activities are as follows:

> I would have to say the percentage one was good. Because I shop, shop for my family and I am good at looking for good deals. I don’t like spending too much money something I can get cheaper in different place. I try to be wise shopper. Be a wise shopper that’s what I have always been taught growing up. Sometime it is

> never to be chap while buying certain things. The whole lesson you taught would pop into my mind, then I can easily relate it.
>
> The fraction, land section one. It was very helpful. Helpful in terms of finding equal pieces or equal denominators.
>
> All [activities] were good, we learn something. It was eye opening, when it comes to 9 tenths in gas price and basically, they are rounding up so I was like wow. When I noticed, it's like now I see it, so it was eye opening. That was good thing you brought it up.
>
> Students learn differently. I am visual, so if I connect the process with the visual and do an actual like you do a real-life experience kind of when we use it, that helps to connect all the dots.

Mathematics Instructional Videos

Three mathematics instructional videos were played in the dpfAV group classroom, one each on decimals, percentages, and fractions. The dVpA group watched only the decimal instructional video. Out of the 7 students of dpfAV, group 3 liked the decimal video best, 3 liked the percent video best, and 1 student liked the fraction video best. Students had mixed attitudes toward the mathematics instructional videos. About 20% of the students had negative attitudes, saying that instructional videos were distracting and interruptive. These students also said that they would perceive instructional videos better if assigned by the professor or if they had already mastered the concept so they could check the video's claims. The other 80% of the students had positive attitudes. According to them, instructional videos were attention-getting and helpful when learning new concepts. They found the videos simple, clear, and very specific to the topic. About 80% of the students found the visual aspects of instructional videos beneficial to their learning. During the interview one student said, "If teacher notices that students are having difficulty with a particular concept and consistent across the group then showing instructional video is a great idea.” The student also mentioned that the combination of all 3 instructional videos, classroom teaching, and real-life activities was helpful in meeting the needs of all the students.

The dVpA group watched only the decimal instructional video, but they found it so helpful that they suggested showing more videos. However, the decimal instructional video was the only video which received strong negative feedback in one of the dpfAV groups. According to the students of that dpfAV group, the decimal instructional video was too child-like, using cartoon characters of a ladybug, a bird and a girl; furthermore, the narrator spoke very slowly and used the phrases like “let’s try it together” or “good job” which sound more suitable for young elementary students than the community college students. Such animations took the focus away from learning. One student said that it was demeaning and interruptive to watch such an animated video. The decimal instructional video was the only instructional video that did not meet the instructional video selection criterion of coherence, which states that extraneous sound, words, or pictures should be excluded.

In regard to instructional videos and mathematics learning, 5 out of 10 students said instructional videos do make a difference in learning because of their visual aspect and clarity. A student said, “If something is not clear go to video.” One student also said that sometimes videos are clearer and less confusing than the professor.

Two out of 10 students had neutral responses. They found instructional videos helpful in some cases but not all the time. One of the students stated that he considers himself an old student in terms of age and noted that he prefers professor over instructional video.

Three out of 10 students felt that instructional videos do not make a difference in learning. Two of them said instructional videos do not make a difference because they just repeat what students have already learned. One student said straight “No” to instructional videos in transitional mathematics courses. This student said, “Instructional video is more appropriate for an entire semester 15 weeks long courses. The condensed class or transitional class is confused enough as it is.” According to her, instructional videos should be considered bonus features and not a big portion of a lesson or course.

The use of instructional videos in future transitional mathematics courses was supported by 80% of the students. Students said that the younger generation appreciates technology and that people often learn through videos and computers, so it is worth continuing in future courses.

One student was completely against the idea of using videos in transitional mathematics courses. She said, “I believe students have to be fully engaged with professor at all times. You are in transition math for a reason. I think videos are more if you have grasp on idea, you have little more time to work on it. It is like here is the bonus feature lets watch this video.”

Other students said that use of instructional videos in class depends heavily on each individual student’s situation, so they felt they could not respond.

All students (except one) provided suggestions to improve the use of instructional videos in transitional mathematics courses. According to the varied responses, instructional videos should be less animated, enjoyable and interesting, slow paced, and should meet the needs of different people. Showing more instructional videos was desirable to 40% of the students. One student said, “It would be nice we all can get on the computer and do exercises based on those videos because it follows through on a learning and re-enforces it."

Chapter V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The final chapter of this dissertation includes three main sections. The first section summarizes the need for and purpose of the study as well as the method it employed. The conclusion section summarizes the answers to all four research questions. The final section offers suggestions for other researchers and educators, as well as recommendations for future research.

Summary

The entire nation is facing the challenge of remedial education. Nationally, 60% of American college students are not ready for college-level work and need remedial mathematics/English course(s) in their first year at college (Attewell et al., 2006; Bailey, 2009; Bailey & Cho, 2010; Grubb, 2011; McCabe, 2003). Nationally, less than 25% of remedial students earn degrees or certificates (Bailey & Cho, 2010); specifically, in the State of Connecticut, only 8% of remedial students earn degrees or certificates within three years in community colleges (CT Pa 12-40 updated 2013). Without meeting the needs of remedial students, it will be difficult to increase the number of college graduates by 5 million by the year 2020, the goal set by President Obama in 2010. In 2012 the Connecticut General Assembly passed “Public Act 12-40,” aimed to redesign remedial programs in the state. The goal of the act was to create short but effective remedial programs.

Mathematics has been considered an obstacle to graduation for remedial students (Dorr, 2012; Stigler, 2010). A lack of mathematics skills will negatively impact not only individuals' academic and professional careers but also the nation's economy as a whole because the US Bureau of Labor Statistics predicted that by 2018 the United States will have about 1 million more jobs in mathematics-related fields. There is a clear need to prepare students, and it is worth conducting studies that can analyze remedial students' mathematics performance and attitude. Research suggests that most remedial students are active, visual, hands-on learners who can profit if content is taught using real-life examples to which they can relate (Bollash, 2013; Canfield, 1976; Lemire, 1998; McCarthy, 1982), but remedial students are frequently taught through traditional lecture methods only.

This study aimed to evaluate the effect of instructional video and real-life activity assisted instruction on remedial students' mathematical achievement, attitude towards mathematics, and attitude towards the use of instructional video and real-life activity in remedial mathematics courses. The study contributed to a statewide experiment seeking to identify the best practices and strategies for effective remedial programs in Connecticut community colleges.

The study was conducted in a remedial mathematics course at a Connecticut urban community college. Students enrolled in the remedial mathematics course voluntarily participated in the study. For the purpose of this study, the first class of the remedial mathematics course offered in spring 2016 was considered a Decimal Video and Percent Activity (dVpA) group and the next three classes were considered Decimal, Percent, Fraction Activity and Video (dpfAV) groups. Three lessons (decimal place value, calculation the percentage of a whole number, and adding fractions with unlike denominators) were designed for implementation in this study. The instructional videos were selected based on eight design principles identified through extensive research by Richard Mayer (2002).

A pre- and post-survey, a pre- and post-test, and a Mathematics Attitude Scale were used to collect quantitative data. Interviews with students and field notes provided additional contextual data.

Conclusions

Overall, the dpfAV students' (students who received instruction through lecture, real-life activity and instructional video) mean post-test score was higher than the dVpA group students' (students who received instruction through lecture method only) mean post-test score, and this difference was statistically significant at the .05 level. The dpfAV group student performance was further analyzed; I found a statistically significant correlation between post-test scores and subjects having learned English as their first language ($r = -.461$, $p < .01$). The reader should interpret this study's findings cautiously, however. Classroom interventions do not necessarily reflect the dynamic of intact classes and the use of different teachers and a possible lack of equivalence in the different classes here could have impacted results.

Research Question 1

What are the experiences of students participating in two different instructional interventions related to decimal, percent and fraction concepts?

The groups were similar in terms of gender and ethnicity but different in terms of the number of working students and elapsed time since their previous mathematics class. Both groups had more females than men, and in both groups close to 50% students were

Hispanic. In the dVpA group more students were working and more students took a mathematics class in the past one year as compared to the dpfAV group. In the dVpA group 67% of the students were working and 40% students had taken a mathematics class in the past year whereas in the dpfAV group 82% of the students were working and 54% of the students had taken a mathematics class in the past year. There is a possibility that taking mathematics course in the past year might influence future performance but due to small sample size this study focused on the correlation between the post-test score and the time-elapsed since the last mathematics class but did not find any significant results.

Though both groups were similar in composition, the dVpA group was presented only one real-life activity, whereas the dpfAV group was presented three real-life activities. Interview responses of both the groups were similar despite the fact that their attitude survey results were different. Based on the interview responses, the majority of students in both groups enjoyed real-life activities and recommended using them in future Transitional Mathematics courses. The attitude survey results of the dVpA group for "Real-life activities in class helped me learn mathematics with greater understanding" went down from 79% to 73% whereas it went up for the dpfAV group from 71% to 86%. The positive interview responses and attitude survey results suggests that the Decimal, Percent, Fraction Activity and Video group benefited from the real-life activity assisted instruction.

With regards to instructional videos, the dVpA group was presented with one video and the dpfAV group was presented with three videos. Most of the dVpA group students had a positive interview response for the use of instructional video and recommended using instructional videos for future Transitional Mathematics courses. For example, their responses to the question, “Video takes away instruction time, not helpful” also went down from 57% to 36%. On the other hand, the dpfAV group students offered mixed reviews for instructional videos and most of them gave very strong negative feedback for the decimal video. Their response to attitude survey question “Video takes away instruction time, not helpful” went up from 15% to 21%.

The analysis of the pre and post-test each individual group indicates that there was no significant gain in achievement for the dVpA group but there was a statistically significant gain for the dpfAV group students.

Research Question 2.a

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematics achievement of students when compared to traditional methods?

The evidence suggests that the instructional video and real-life activity assisted instruction does make a difference in students' mathematical achievement. The mathematical achievement of the dpfAV group was stronger than the mathematical achievement of the dVpA group. The mean post-test score of dpfAV group was greater than the mean post-test score of the dVpA group, and it was statistically significant at the .05 level.

Similar results were found when the post-test scores of fraction questions were compared. In the dVpA group the fraction concept was taught through traditional methods, and in the dpfAV group fraction concept was taught using instructional video and real-life activity assisted instruction. The dpfAV group performed better than the the dVpA group, which suggests that instructional video and real-life activity assisted instruction can impact student achievement.

To make the claim stronger or to further justify this conclusion, I compared students' performance within the dVpA group but for different sub-category (fraction, decimal and percent) questions. The results within the dVpA group indicated a statistically significant difference ($\alpha = 0.5$) between the mean post-test score of students taught by instructional video assisted instruction and the students taught by traditional methods. Similarly, there was a statistically significant difference ($\alpha = 0.5$) between the mean post-test score of students taught by real-life activity assisted instruction and the students taught using traditional methods. We conclude that both instructional video and real-life activity, individually as well as combined, affect students' mathematical achievement.

The result of this study suggests that if students are taught through instructional video and real-life activities, their post-test performance improves. This study suggests using both instructional video and real-life activity to teach fraction concepts to future transitional students.

Research Question 2.b

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematics achievement of students when compared to supporting traditional instruction with instructional videos?

In this research question I compared video assisted instruction (dVpA group) versus video and real-life activity assisted instruction (dpfAV group). The analysis of data did not indicate any significant difference between the two groups' mathematical achievement. This research question was investigated by calculating the mean of the correct responses to decimal place value questions in the post-test and then conducting a t-test to determine whether there was a significant difference between the dVpA and the dpfAV groups' mathematical achievement. The difference in mean post-test scores was not found to be statistically significant at the .05 level, which suggests that supporting traditional instruction with instructional videos and real-life activities is no more effective than traditional instruction employing instructional videos only. *This study found that traditional instruction with instructional videos and real-life activities was no more effective than traditional instruction employing instructional videos only. Additional research might well investigate this issue.*

Research Question 2.c

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on the mathematics achievement of students when compared to supporting traditional instruction with real-life activities?

The mean of the correct responses to the percent question and t-test analysis indicated that the difference in the mean post score of the dpfAV group and the mean post score of the dVpA group was not statistically significant at the .05 level. The evidence suggests that there is no difference in the mathematical achievement of students taught by real-life mathematics activity assisted instruction and students taught by instructional video and real-life assisted instruction.

Research Question 3

Does supporting traditional instruction with instructional videos and real-life activities have a positive impact on mathematical attitudes of students?

A statistically significant difference was not found between the mathematical attitudes of students taught by the instructional video and real-life activity assisted instruction and the mathematical attitudes of students taught using traditional methods. Though there was no significant difference, the dpfAV group mean for the attitude survey was higher. Also, the analysis of the dpfAV group's pre- and post-survey indicates that mathematical attitudes of students changed, and that they changed positively. There was a more than 100% increase in the number of students who expressed self-confidence in their mathematical skills. Also, real-life activities appeared to help students develop a positive mathematical attitude; the number of students who agreed or strongly agreed that real-life activities helped them learn mathematics with greater understanding increased from 71% in the pre-test to 86% in the post-test.

No conclusion could be drawn about changes in the anxiety subscale of the Fennema Sherman Mathematics Attitude Scale. The scores of 14 students showed statistically significant improvement: 9 students' score went down (a statistically significant result) and 2 students' scores stayed the same. Overall, the percentage of students with low anxiety increased and the percentage of students with high anxiety decreased, a result without statistical significance.

Research Question 4

What are transitional mathematics course students' attitudes towards the use of instructional videos and real-life activities in their mathematics course?

Students reported positive attitudes towards the use of instructional video and real-life activities in the transitional mathematics courses. In interviews, about 90% of the students said real-life activities helped them to understand the mathematical concepts and helped them see the connection between classroom mathematics and real-life mathematics. Most of the students found the activities useful because they brought a change in their monotonous classroom pattern of drill work. The provision of multiple ways of teaching was helpful in meeting the needs of many students.

About 80% of the students I interviewed found the visual aspects of instructional videos beneficial to their learning. This study's results appear to support Mayer's (2002) selection criteria for instructional videos. In fact, the only video which received negative feedback was the one that violated Mayer's criterion of coherence (extraneous sounds, words, or pictures are excluded). About 20% of the students I interviewed found the decimal video too childish with its cartoon characters and the slow tone of the narrator.

Recommendations

This study does offer some cautions for other researchers. Collaborating with instructors and other staff members of the community college in this study was a challenge due to the time constraints and, perhaps, a natural reluctance to make any changes to traditional teaching methods. Future researchers should consider exploring the use of instructional videos and activities for more mathematical concepts in addition to fractions, decimals, and percentages. Future researchers may also choose to study the sequence of mathematical concepts in the curriculum, examining post-test performance to identify if teaching towards the end of the course (right before the post-test), in the middle of the course, or in the beginning of the course (way before the post-test) makes any difference in mathematical achievement and mathematical attitude.

Transitional mathematics courses teach the fundamental concepts of mathematics to adult learners. Students did not enjoy the typical teaching approach used in the transitional mathematics course as it focused on worksheets or drill work. I used instructional videos and activities, but some of the students were not engaged by one of the instructional videos because they felt it was targeted to younger students. Though that one video did not meet all eight design principles, I selected it for my research due to the lack of a better one; therefore, one of my recommendations for future studies is that the researcher make sure that the instructional videos selected for the lessons meet all eight design principles discussed in this study. Another recommendation concerns the design of materials which support learning of fundamental concepts for adults because some students suggested making the real-life activities more challenging.

The study presents several interesting and important recommendations not only for future researchers but also for teachers. Teachers should understand the recommended design principles for instructional videos. Making teachers aware of these principles and helping them to use them requires collaboration from educational institutions, school staff and administration, authors of mathematics textbooks and curriculum, parents, and finally students themselves.

I would encourage teachers to integrate technology into their classroom instruction. The abundance of resources can make this an overwhelming endeavor. So, for an easy and quick start, I would recommend simply including short videos at the end of class to review and reinforce concepts. Videos are simple and easily available through a Google search for any given concept. After finding potentially useful videos, check their duration, read their brief description, and watch them to make sure they meet content requirements, are suitable for the age group you are targeting, and that's it - you are all set to integrate videos in your teaching. Apart from the Google search other useful resources are also available: Teacher Tube, LearZillion, MathAntics, tecmath, Illumination by NCTM, MathHelp, and Khan Academy.

Educational institutions should consider designing a course or professional development program for selecting and using instructional videos that promote learning. The course should aim to make prospective and in-service teachers well versed with the design principles of instructional videos identified by Richard Mayer. Teachers should consider using these design principles for selecting instructional videos to use in their classrooms. Teachers should be both encouraged and willing to make necessary changes to their traditional teaching to incorporate instructional videos. If possible, the school administration should form a committee of teachers to test the instructional videos based on the design principles. The committee could create a website or online space to save these videos for future use by all of the institution's teachers and eventually make them available to the public. Also, the school administration should provide required technical assistance to teachers to incorporate instructional videos in their traditional teaching practices. The writers of mathematics curriculum and textbooks can play a crucial role here. They may test the existing instructional videos, instead of creating new ones, based on appropriate design principles and can provide appropriate links with each lesson. Teachers and curriculum developers should keep a database of videos that meet all or most of the design principles. This systemic adoption cannot be completed without student involvement. Teachers should share the link with students so they could watch instructional videos at home to review concepts or while working on assignments. One of the design principles that promotes learning is the interactivity principle, which indicates that learners should control the presentation; basically, learners should be able to play, reply, or to stop the videos for a positive impact on their learning.

Some of the aspects of this study can be used as a basis for future research. Three real-life activities were used in this study; one of the activities was adapted from the NSF-funded Connected Mathematics Program (CMP) (Lappan, Fey, Fitzgerald, Friel & Phillips, 1997) and the other two were designed by the researcher. There were no readily available principles or criteria to design real-life activities that promote better understanding. Galbraith (2006) discussed six design principles that emerged from student responses to a wide range of real-world problems; these principles are in progress and need further refinement and fine-tuning. Galbraith (2006) also stated that it has been more than four decades since Pollak encouraged the entire educational community to focus on mathematics applications and modeling. Mathematics modeling and mathematics applications are the foundation for future research studies related to real-life mathematics activities. Research related to design principles for real-life activities would benefit the entire educational system as teaching through real-life application is considered to be among the best teaching practices.

I strongly feel that the research on real-life activity is needed the most. There are several terms like real-life, real-world, application of mathematics in the real world, or mathematics modeling, and their descriptions overlap. There is no one definition for many of them, and they have different meanings for different people. Also, it is challenging to evaluate a teacher's ability to teach and implement real-life activities.

If future researchers are interested in conducting similar studies, it would be worth conducting a study in more than one community college as well as providing bigger sample sizes and a better perspective on student attitudes towards the use of instructional video and real-life activities. In order to get a better perspective, I suggest a greater focus on interviews. If possible, I would conduct pre and post interviews and ask for evidence for the responses. Include a small test in the interview or ask a student to solve a mathematics problem. This will help researchers to assess the impact of videos or activities on their understanding and application of the concept.

Future researchers might also consider the impact of new video formats. Recently, auto-play videos have become popular. Auto-play videos play automatically, and their sound is muted unless one clicks on them. Auto-play videos are common on social media. Future research might well focus on auto-play video's impact on student attention spans, learning techniques, and teaching strategies. The effect of gender differences or differences between young learners and adult students is also worth exploring.

Integration of auto videos may require modification of existing lesson plan formats. Future researchers might study the pattern of lesson plan change over a period of time due to the integration of technology, or the focus of the study could be entirely on a new way of developing lesson plans that incorporates videos and real-life activities. The study might outline the characteristics of a good lesson plan. It would be worth defining "good lesson plan" in terms of prompting students' understanding of the concepts and their alignment with Common Core State Standards.

REFERENCES

Advisory Committee on Student Financial Assistance, (May, 2008). TRANSITION MATTERS: Community college to bachelor's degree. A proceeding report of the advisory committee on student financial assistance.

Alexander, C. M. (2013). *Community college developmental education students' understanding of foundational fraction concepts* (Order No. 3614168). Available from ProQuest Dissertations and Theses Global. (1517925113). Retrieved from http://eduproxy.tc-library.org/?url=/docview/1517925113?accountid=14258

Allison, C. (2015). *The use of instructional videos in K-12 classrooms: A mixed-method study* (Doctoral dissertation, Indiana University of Pennsylvania).

American Association of Community Colleges (2011). The College Completion Challenge Toolkit - Fact Sheet.

Armington, T. (2002). *Best practices in developmental mathematics*. Mathematics Special Professional Interest Newtwork.

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current directions in psychological science*, *11*(5), 181-185.

Attewell, P., Lavin, D., Domina, T., & Levey, T. (2006). New evidence on college remediation. *The Journal of Higher Education* 77(5), 886-924

Bailey, T. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community college. *New directions for community colleges*, *2009*(145), 11-30.

Bailey, T. & Cho, S. (2010). Developmental education in community college (Issue Brief). Retrieved from http://ccrc.tc.columbia.edu/media/k2/attachments/developmentaleducation-community-colleges.pdf

Baron, K. (May, 2015). Escape from Math Phobia. Carnegie Foundation for the Advancement of Teaching.

Behr, M. J., Lesh, R., Post, T., & Silver, E. A. (1983). Rationals number concepts. *Acquisition of mathematics concepts and processes*, 91-126.

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences*, *107*(5), 1860-1863.

Bendickson, M. M. (2004). The impact of technology on community college students' success in remedial/developmental mathematics.

Berk, R. A. (2009). Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom. *International Journal of Technology in Teaching and Learning*, 5(1).

Betrancourt, M. (2005). The animation and interactivity principles in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 287–296). New York, NY: Cambridge University Press.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational behavior*, *23*(3), 329-345.

Blair, R. M. (Ed.). (2006). Beyond crossroads: Implementing mathematics standards in the first two years of college. *American Mathematical Association of Two-Year Colleges*.

Boatman, A. (2018). Supplemental Study: Exploring of the use of Learning Technologies in Developmental Math. Center for The Analysis of Postsecondary Readiness (CAPR). Retrieved from https://postsecondaryreadiness.org/research/projects/ supplemental-study-learning-technologies/

Bollash, M. C. (2013). Remedial learners in a community college setting contribute to their own academic success: Identifying effective teaching and learning strategies, delivery methods and instructional technologies for remedial learners (Order No. 3558140). Available from ProQuest Dissertations and Theses Global. (1348693610). Retrieved from http://eduproxy.tc-library.org/?url= /docview/ 1348693610? accountid=14258

Bonham, B. S., & Boylan, H. R. (2011). Developmental mathematics: Challenges, promising practices, and recent initiatives. *Journal of Developmental Education*, *34*(3), 2.

Boylan, H. R. (2002). *What works: Research-based best practices in developmental education*. Continuous Quality Improvement Network with the National Center for Developmental Education.

Boylan, H. R., Bliss, LB & Bonham, BS (1997). Program Components and Their Relationship to Student Performance. *Journal of Developmental Education* (Vol. 20, No. 3, pp. 365-402).

Boylan, H. R., Bonham, B. S., Claxton, C., & Bliss, L. B. (1992, November). The state of the art in developmental education: Report of a national study. In *First National Conference on Research in Developmental Education, Charlotte, NC.*

Boylan, H. R., & Saxon, D. P. (1999). What works in remediation: Lessons from 30 years of research. *Unpublished report. Retrieved October*, *14*, 2006.

Boylan, H. R., & Saxon, D. P. (2006). Affirmation and discovery: Learning from successful community college developmental programs in Texas. *Research contracted by the Texas Association of Community Colleges. Retrieved March*, *12*, 2007.

Brothen, T. (1992). Ideas in practice: A developmental education approach to computer-assisted content instruction. *Journal of Developmental Education*, *15*(3), 32.

Brown, G., & Quinn, R. J. (2007). Fraction Proficiency and Success in Algebra: What Does Research Say?. *Australian Mathematics Teacher*, *63*(3), 23-30.

Bryk, A. S., & Treisman, U. (2010). Make math a gateway, not a gatekeeper. *Chronicle of Higher Education*, *56*(32), B19-B20.

Cafarella, B. V. (2013). *Exploring best practices in developmental mathematics*. University of Dayton.

Cafarella, B. V. (2014). Exploring Best Practices in Developmental Math. *Research and Teaching in Developmental Education*, *30*(2).

California. Curriculum Development, Supplemental Materials Commission, California. State Board of Education, & California. Department of Education. (2006). *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve*. California Department of Education.

Canfield, A. (1976). The Canfield learning styles inventory: Technical manual. *Ann Arbor, MI: Humanics Media*.

Casazza, M., & Silverman, S. (1996). Learning assistance and developmental education. San Francisco, CA: Jossey-Bass.

Chinapen, R. (2015, December 3). Connecticut's end to remedial college classes bring new way to help students. No noncredit remedial courses offered this fall. *New Haven Register*. Retrieved from http://www.newhavenregister.com

Clutts, D. W. (2010). *Mathematics self-efficacy of community college students in developmental mathematics courses*. Liberty University.

Clyburn, G. M. (2013). Improving on the American dream: Mathematics pathways to student success. *Change: The Magazine of Higher Learning*, *45*(5), 15-23.

Connecticut Public Act 12-40 (updated 2013) An Act concerning college readiness and completion.

Creemers, B., Kyriakides, L., & Antoniou, P. (2012). *Teacher professional development for improving quality of teaching*. Springer Science & Business Media.

Cross, K. (1976). Accent on learning. San Francisco, CA: Jossey-Bass.

DeCesare, J. A. (2014). The expanding role of online video in teaching, learning, and research. *Library Technology Reports*, *50*(2), 5-11.

Deimann, M., & Keller, J. M. (2006). Volitional aspects of multimedia learning. *Journal of Educational Multimedia and Hypermedia*, *15*(2), 137.

Desrochers, K. [LearnZillion]. (n.d.). Add fractions with unlike denominators by creating area models. Retrieved from https://learnzillion.com/lesson_plans/6861-add-fractions-with-unlike-denominators-by-creating-area-models,/lesson

Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and brain functions*, *8*(1), 33.

Donchev, D. (2018). 37 Mind blowing YouTube facts, figures and statistics – 2018. Retrieved from https://fortunelords.com/youtube-statistics/

Dorr, P. M., (2012). Gov. Brown Signs Student Success Act of 2012 into law. California Community College Chancellor's office. Retrieved from http://www.california communitycolleges.cccco.edu/Portals/0/DocDownloads/PressReleases/SEP2012/PRESS_RELEASE_SB1456StudentSuccessActSigned_FINAL_092712.pdf

Dowker, A., Bennett, K., & Smith, L. (2012). Attitudes to mathematics in primary school children. *Child Development Research*, *2012*.

Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: what have we learned in 60 years? *Frontiers in psychology*, *7*.

Elliot, S. (2008, September). Understanding Multimedia Learning: Integrating multimedia in the K-12 classroom. Retrieved from https://www.brainpop.com/new_common_images/files/76/76426_BrainPOP_White_Paper-20090426.pdf

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: a meta-analysis. *Psychological bulletin*, *136*(1), 103.

Eshun, B. (2004). Sex-differences in attitude of students towards mathematics in secondary schools. *Mathematics Connection*, *4*(1), 1-13.

Fadel, C., & Lemke, C. (2008). Multimodal learning through media: What the research says. *San Jose, CA: Cisco Systems*, 1-24.

Farooq, M. S., & Shah, S. Z. U. (2008). STUDENTS'ATTITUDE TOWARDS MATHEMATICS. *Pakistan Economic and Social Review*, 75-83.

Felder, R. M., & Soloman, B. A. (1991). Index of learning styles.

Fennell, F. (2007). Fractions are foundational. NCTM News Bulletin, 3.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for research in Mathematics Education*, *7*(5), 324-326.

Finney, J. E., & Stoel, C. F. (2010). Fostering Student Success: An Interview with Julie Phelps Virginia B. Smith Innovative Leadership Award Recipient for 2010. *Change: The Magazine of Higher Learning*, *42*(4), 38-43.

FreeTestPrep. (201, November 19). Calculate Percentages in your head. Retrieved form https://www.youtube.com/watch?v=ZBOBfZT562c

Gal, I. (2000). The numeracy challenge. In I. Gal (Ed) Adult numeracy development: Theory research practice (pp 9-13). Cresskill, NJ: Hampton Press

Galbraith, M.W., & James, W.B. (2002). Implications of social role research for community colleges. *Community College Journal of Research and Practice, 26,* 521-533

Galbraith, M. W., & Jones, M.S. (2006). The art and science of teaching developmental Mathematics: Building perspective through dialogue. Journal of Developmental Education, 30 (2), 20-27.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. NY: Basic books.

Gardner, H. (1993). Multiple intelligences: The theory in practice. New York: Basic.

Gardner, H. E. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York Basic Books

Gardner, H. (2005, May). Multiple lenses on the mind. In *ExpoGestion Conference, Bogota Colombia* (pp. 1-29).

Gardner, H., & Hatch, T. (1989). Educational implications of the theory of multiple intelligences. *Educational researcher*, *18*(8), 4-10.

Gautreau, C., Brye, M. V., & Lunceford, C. (2016). Mathematics-related anxiety and attitudes: examining the impact among Latina preservice teachers. *Journal of Latinos and Education*, *15*(1), 26-38.

Girod, M., Bell, J., & Mishra, P. (2007). Using digital video to re-think teaching practices. *Journal of Computing in Teacher Education*, *24*(1), 23-29.

Glasgow, R., Ragan, G., Fields, W. M., Reysi, R., & Wasman, D. (2000). The decimal dilemma. *Teaching Children Mathematics*, *7*(2), 89.

Glossers, G. [Math Goodies]. (2008). Place Value and Decimal Chart. Retrieved from https://www.tidyform.com/download/decimal-place-value-chart-1.html

Golfin, P., Jordan, W., Hull, D., & Ruffin, M. (2005). Strengthening Mathematics Skills at the Postsecondary Level: Literature Review and Analysis. *US Department of Education*.

Grubb, W. N., Boner, E., Frankel, K., Parker, L., Patterson, D., Gabriner, R., Hope, L., Schiorring, E., Smith, B., Taylor, R., Walton, I., & Wilson, S. (2011). Understanding the "crisis" in basic skills: Framing the issues in community colleges. Working paper. Policy Analysis for California Education.

Harp, S. F., & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of educational psychology*, *90*(3), 414.

Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for research in mathematics education*, 33-46.

Holmes, V., Clark, W., Burt, P., & Rienties, B. (2013). Engaging teachers (and students) with media streaming technology: the case of Box of Broadcasts. In *Increasing student engagement and retention using mobile applications: smartphones, Skype and texting technologies* (pp. 209-238). Emerald Group Publishing Limited.

Holton, D., Muller, E., Oikkonen, J., Sanchez Valenzuela, O. A., & Zizhao, R. (2009). Some reasons for change in undergraduate mathematics enrolments. *International Journal of Mathematical Education in Science and Technology*, *40*(1), 3-15.

Huang, T. (. (2008). *The role of task-specific adapted knowledge of response feedback in algebra problem solving online homework in a college remedial course* (Order No. 3325192). Available from ProQuest Dissertations and Theses Global. (304461629). Retrieved from http://eduproxy.tc-library.org/?url=/docview/304461629?accountid=14258

Jones, T., & Cuthrell, K. (2011). YouTube: Educational potentials and pitfalls. *Computers in the Schools*, 28(1), 75-85.

Johnson, D. W., & Johnson, R. T. (1996). Cooperation and the use of technology. *Handbook of research for educational communications and technology: A project of the Association for Educational Communications and Technology*, 1017-1044.

Johnson, L., Adams, S., & Cummins, M. (2012). NMC Horizon Report: 2012 K–12 Education. *Austin, TX: The New Media Consortium*.

Kagan, S., & Kagan, M. (1998). Multiple intelligences. *The Complete MI Book. San Clemente, CA: Kagan Cooperative Learning*.

Karadag, E., & Karadeniz, I. (2014). [EXTENDED ABSTRACT] Mathematics Anxiety and Attitudes of Secondary School Students in Rural Areaand58; A Correlational Research and91; Kırsal Bölgelerdeki Ortaokul Öğrencilerinin Matematik Kaygı ve Tutumlarıand58; Korelasyonel Bir Araştırmaand93. *Turkish Journal of Computer and Mathematics Education*, *5*(3), 259-273.

Kaufman, P. B., & Mohan, J. (2009). Video use and higher education: Options for the future. *Retrieved August*, *15*, 2009.

Keup, J. R. (1998). *Using technology in remedial education*. ERIC Clearinghouse for Community Colleges, University of California at Los Angeles.

Kishawi, D. (2015). Best Teaching Methods for College Developmental Math Classes.

Kiss, A. J., & Vukovic, R. (2017). Math Anxiety and Attitudes Toward Mathematics: Implications for Students with Mathematics Learning Disabilities. *Perspectives on Language and Literacy*, *43*(1), 35.

Kulik, C-L., & Kulik, J. (1991). Developmental instruction: An analysis of the research. Boone, NC: National Center for Developmental Education, Appalachian State University.

Kulik, J. A. (1994). Meta-analytic studies of findings on computer-based instruction. *Technology assessment in education and training*, *1*, 9-34.

Lappan, G., Fey, J. T., Fitzgerald, W. M., Friel, S. N., & Phillips, E. D. (1997). Comparing and scaling: Ratio, proportion, and percent—the Connected Mathematics Project. *Palo Alto, Calif.: Dale Seymour Publications*.

Lembke, L. O., & Reys, B. J. (1994). The development of, and interaction between, intuitive and school-taught ideas about percent. *Journal for Research in Mathematics Education*, 237-259.

Lemire, D. (1998). Three Learning Styles Models: Research and Recommendations for Developmental Education. *Learning Assistance Review*, *3*(2), 26-40.

Levin, H. M., & Calcagno, J. C. (2008). Remediation in the community college: An evaluator's perspective. *Community College Review*, *35*(3), 181-207.

Lortie-Forgues, H., Tian, J., & Siegler, R. S. (2015). Why is learning fraction and decimal arithmetic so difficult? *Developmental Review*, *38*, 201-221.

Maloney, E. A., & Beilock, S. L. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. *Trends in cognitive sciences*, *16*(8), 404-406.

Martelly, D. I. (1998). *Effects of using manipulative materials to teach remedial algebra to community college students on achievement and attitudes towards mathematics* (Order No. 9826062). Available from ProQuest Dissertations and Theses Global. (304489744). Retrieved from http://eduproxy.tc-library.org/?url=/docview/304489744?accountid=14258

Martin, D. B. (2003). Hidden assumptions and unaddressed questions in mathematics for all rhetoric. *The Mathmatics Educator*, *13*(2).

Mata, M. D. L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *Child development research*, *2012*.

Math Coach. (2012, April 12). How to read a decimal. Retrieved from https://www.youtube.com/watch?v=qQ4YaNkA7_4

Maurer, S. B. (2000). College entrance mathematics in the year 2000--what came true? *The Mathematics Teacher*, *93*(6), 455.

Mautone, P. D., & Mayer, R. E. (2001). Signaling as a cognitive guide in multimedia learning. *Journal of educational Psychology*, *93*(2), 377.

Mayer, R. E., (1997). Multimedia Learning: Are we asking the right questions? Educational *Psychologist*, *32*(1), 1-19.

Mayer, R. E. (2002). Cognitive theory and the design of multimedia instruction: an example of the two□way street between cognition and instruction. *New directions for teaching and learning*, *2002*(89), 55-71.

Mayer, R. E. (2003). The promise of multimedia learning: using the same instructional design methods across different media. *Learning and instruction*, *13*(2), 125-139.

Mayer, R. E., & Anderson, R. B. (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of educational psychology*, *83*(4), 484.

Mayer, R. E., & Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of educational Psychology*, *84*(4), 444.

Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of educational psychology*, *93*(2), 390.

Mayer, R. E., Heiser, J., & Lonn, S. (2001). Cognitive constraints on multimedia learning: When presenting more material results in less understanding. *Journal of educational psychology*, *93*(1), 187.

Mayer, R. E., & Moreno, R. (1998). A split-attention effect in multimedia learning: Evidence for dual processing systems in working memory. *Journal of educational psychology*, *90*(2), 312.

McCabe, R. H. (2000). *No one to waste: A report to public decision-makers and community college leaders*.

McCabe, R. H. (2003). *Yes, We Can! A Community College Guide for Developing America's Underprepared*. Community College Press, One Dupont Circle NW, Ste. 410, Washington, DC 20036.

McCabe, R. H., & Day Jr, P. R. (1998). Developmental Education: A Twenty-First Century Social and Economic Imperative.

McCarthy, B. (1982). Learning styles and developmental education. *Kellogg Institute for the Training and Certification of Developmental Educators, Appalachian State University, Boone, NC*.

McClendon, M., & McArdle, M. (2002). Comparing Alternative Algebraic Modalities for Remedial Students.

McMillan, V. K., Parke, S. J., & Lanning, C. A. (1997). Remedial/developmental education approaches for the current community college environment. *New Directions for Community Colleges*, *1997*(100), 21-32.

Merseth, K. K. (2011). Update: Report on Innovations in Developmental Mathematics--Moving Mathematical Graveyards. *Journal of Developmental Education*, *34*(3), 32.

Mesa, V., Wladis, C., & Watkins, L. (2014). Research problems in community college mathematics education: Testing the boundaries of K—12 research. *Journal for Research in Mathematics Education*, *45*(2), 173-192.

Milford, M. (2008, January 24). Professor: Fractions should be scrapped. *USA Today*. Retrieved from https://www.usatoday.com

Moore, A. (1993). Computer Assisted Instruction (ILS) for Adults.

Moran, M., Seaman, J., & Tinti-Kane, H. (2012). Blogs, wikis, podcasts and Facebook: How today's higher education faculty use social media. *Boston, MA: Pearson Learning Solutions. Retrieved December*, *22*, 2012.

Moreno, R., & Mayer, R. E. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of educational psychology*, *91*(2), 358.

Moreno, R., & Mayer, R. E. (2000). A coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. Journal of Educational Psychology, 92(1), 117.

Moreno, R., & Valdez, A. (2005). Cognitive load and learning effects of having students organize pictures and words in multimedia environments: The role of student interactivity and feedback. Educational Technology Research and Development, 53(3), 35-45.

National Center for Education Statistics (Ed). (2013). The Nation's Report Card: Trends in Academic Progress 2012. Nces 2013-456.

National Council of Teachers of Mathematics (Ed.). (2000). Principles and standards for school mathematics (Vol. 1). National Council of Teachers of.

National Mathematics Advisory Panel. (2008). Foundations for success: The final report of the National Mathematics Advisory Panel. US Department of Education.

Neale, D. C. (1969). The role of attitudes in learning mathematics. The Arithmetic Teacher, 16(8), 631-640.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. Educational psychologist, 38(1), 1-4.

Pai, A. (2014). A picture worth a thousand words? Making a case for video case studies. Journal of College Science Teaching, 43(4), 63-67.

Peel, J. J. (2010). Algebra I plus program: Does double the time and a remedial curriculum improve a student's perceptions of math and achievement in algebra I?(Order No. 3440494). Available from ProQuest Dissertations and Theses Global. (854512889). Retrieved from http://eduproxy.tc-library.org /?url =/ docview/854512889?accountid=14258

Polk, M., & Kertesz, A. (1993). Music and language in degenerative disease of the brain. Brain and cognition, 22(1), 98-117.

Porter, C. (2014, Feb 17). Remedial college courses face a new test; law lets students decide whether they need basic classes. Wall Street Journal (Online)Retrieved from http://ezproxy.cul.columbia.edu/login?url=https://search-proquest-com. ezproxy.cul.columbia.edu/docview/1498563151?accountid=10226

Postman, N. (2006). Amusing ourselves to death: Public discourse in the age of show business. Penguin.

Purcell, K. (2013). Online video. PEW Internet.

Rapp, R. H., & Gittinger, D. J. (1993). *Using computers to accommodate learning disabled students in mathematics classes* Retrieved from http://eduproxy.tc-library.org/?url=/docview/62803387?accountid=14258

Ren, L., Green, J. L., & Smith, W. M. (2016). Using the Fennema-Sherman Mathematics Attitude Scales with lower-primary teachers. *Mathematics Education Research Journal*, *28*(2), 303-326.

Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of counseling Psychology*, *19*(6), 551.

Rogers, P. (2009). What Does the Little 9 Mean. Retrived from https://www.nbcchicago.com/news/business/What-Does-the-Little-9-Mean.html).

Roueche, J. (1968). Salvage, redirection, or custody? Washington, DC: American Association of Junior Colleges.

Roueche, J., & Wheeler, C. (1973, summer). Instructional procedures for the disadvantaged. Improving College and University Teaching, 21, 222-225.

Sambo, A. A. (1980). Transfer effects of measure concepts on the learning of fractional numbers Unpublished doctoral dissertation, University of Alberta.

Senserrich, R. (2014). Developmental Education Reform: Ensuring Success for all in Connecticut, Hartford, CT: Connecticut Association for Human Services.

Seok, S. (Ed.). (2010). Handbook of Research on Human Cognition and Assistive Technology: Design, Accessibility and Transdisciplinary Perspectives: Design, Accessibility and Transdisciplinary Perspectives. IGI Global.

Sharp, B. B. (2002). Understanding relationships among fraction, decimal, and percent concepts.

Sherer, P., & Shea, T. (2011). Using online video to support student learning and engagement. *College Teaching*, *59*(2), 56-59.

Shipper, F. (2013). If a picture is worth 1,000 words, is a video worth 3,000 words? A Review of Video Resources Available for Use in Today's Management Classroom. *Academy of Management Learning and Education*, *12*(4), 684-686.

Silverman, S. L. & Casazza, M. E., (2000). Learning and development: Making connections to enhance teaching higher and adult education series.

Smittle, P. (2003). Principles for effective teaching. *Journal of Developmental Education*, *26*(3), 10-16.

Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science?: a critical review. *American Psychologist*, *60*(9), 950.

Statistics B. (2016). YouTube Company Statistics. Retrieved from https://www.statisticbrain.com/youtube-statistics/

STEMEd Caucus Steering Committee. (2008). Why was the STEM Education Caucus created? Available from STEMEd Caucus Steering Committee Web site: http://www. stemedcaucus. org.

Stigler, J. W., Givvin, K. B., & Thompson, B. J. (2010). What community college developmental mathematics students understand about mathematics. MathAMATYC Educator, 1(3), 4-16.

Sweeney, E. S., & Quinn, R. J. (2000). Concentration: Connecting fractions, decimals and percents. *Mathematics teaching in the middle school*, *5*(5), 324.

Tapia, M. (1996). The Attitudes toward Mathematics Instrument.

Thompson, B. E. (2008). *The effects of remedial college algebra on grades in the first math class* (Order No. 1460561). Available from ProQuest Dissertations and Theses Global. (304398876). Retrieved from http://eduproxy.tclibrary.org/? url=/docview/304398876?accountid=14258

Thornhill, S., Asensio, M., & Young, C. (2002). Video streaming: a guide for educational development. *San Francisco: JISC/DNER Click y Go Video Project*.

Tobias, S., & Weissbrod, C. (1980). Anxiety and mathematics: An update. *Harvard Educational Review*, *50*(1), 63-70.

U.S. Department of Education, Office of Science and Technology Policy. Office of Management and Budget (2010). *Preparing our children for the future science, Technology Engineering and Mathematics (STEM) education in the 2011 budget.* Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/stem_11_final.pdf

U.S. White House (2012). *Building American Skills through community college*. Retrieved from https://www.whitehouse.gov/sites/default/files/100326-community-college-fact-sheet.pdf

Vandal, B. (2011). Return on investment: Strategies for improving remedial education. National Governors Association. Retrieved from https://www.cccs.edu/Docs/deved/NGA%20complete%20to%20compete.pdf

Walton, G. M., & Cohen, G. L. (2003). Stereotype lift. *Journal of Experimental Social Psychology*, *39*(5), 456-467.

Waycaster, P. (2001). Factors impacting success in community college developmental mathematics courses and subsequent courses. Community College Journal of Research and Practice, 25, 403-416.

Weinstein, B. (2010). Obama reaffirms support for community college at signing of student loan bill. The Chronicle of Higher Education. Retrieved from http://chronicle.com/article/Obama-Reaffirms-Support-for/64877/

Wigfield, A., & Meece, J. L. (1988). Math anxiety in elementary and secondary school students. *Journal of educational Psychology*, *80*(2), 210.

Williams, W. (1988). Answers to questions about math anxiety. *School science and mathematics*, *88*(2), 95-104.

Williams, W. M., Blythe, T., White, N., Li, J., Gardner, H., & Sternberg, R. J. (1996). Practical intelligence for school. NY: HarperColllins College Publishers.

Wilson, A. M. (1992). *The INVEST Program: A Computer-Based System for Adult Academic Upgrading. A Pilot Study*. Research report, Cumberland Campus of Nova Scotia Community College. (ED 377 896).

Woodward, J., Baxter, J., & Robinson, R. (1999). Rules and reasons: Decimal instruction for academically low achieving students. *Learning Disabilities Research and Practice*, *14*(1), 15-24.

Yenilmez, K., Girginer, N., & Uzun, O. (2007). Mathematics anxiety and attitude level of students of the Faculty of Economics and Business Administrator; The Turkey Model. In *International Mathematical Forum* (Vol. 2, No. 41, pp. 1997-2021).

Appendix A: Pre- Post-test

Pre-Test

1. Add fractions: ½ + ¾ = ________
2. On Aug 8th AAA national average gas price is $2.605. We write money in terms of hundredths so gas price should be $2.60 so what does the digit 5 represent? Show and explain your work.
3. Calculate 10% of $35. ________________
4. Macy's is offering 60% discount on Ralph Laurent shirt. The original price of the shirt is $80. Marshall's have same Ralph Lauren shirt for $34. Would you buy at Macy's or Marshall's? Why? Show and explain your work. (Ignore tax)
5. You are planning to make Spinach Dip Bites for an appetizer. You have ½ cup of mozzarella cheese but need ¼ cup more so all together how much mozzarella cheese you are using in Spinach Dip Bites.

Post-Test

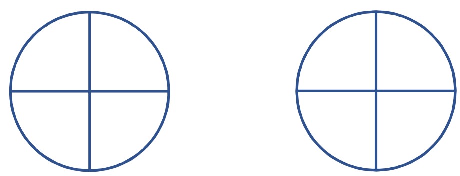
1. Add fractions: 1/3 + 3/5 = ________
2. There are 8 friends who are splitting $15. In calculator when they did $15 divide by 8 they got $1.875 and now they all are confuse because we write money in hundredths so it should be $1.87 so
3. What does the digit 5 represent? What is the place value of 5? ______________
4. How much each person actually gets? _______________
5. Calculate 20% of $ 25. ________________

6. JC Penny is offering 60% discount on Ralph Laurent shirt. The original price of the shirt is $80. Marshall's have same Ralph Lauren shirt for $34. Would you buy at JC Penny or Marshall's? Why? Show and explain your work. **(Ignore tax)**

Answer: I would buy at _______________ because ______________________

Work:

7. I ate ¼ of a personal pizza then I add 1/8 of the other personal pizza. How much did I eat in all? _____________ (NOTE: I do shade 1/4th and make 8 pieces in the other and shade 1/8th too)



Appendix B: Pre and Post Survey

<u>Pre-Survey Questions</u>

What is your gender?

Male

Female

How old are you? ____________Years

What is your ethnicity?

African American

Asian

Hispanic

White

Other ___________

How long you have been living in the United States? ___________

Is English your first language?

Yes

No

What language did you speak in your home while growing up? ____________

What language do you speak in your home now? _______________

Do you currently have a job?

Yes

No

If yes, how many hours per week are you currently working?

1-20 Hours

21-40 Hours

Over 40 Hours

How long it had been since the last mathematics class?

1 year or less

2 years

3-5 years

More than 5 years

I believe I would be good at solving mathematics problems in this "Transitional Mathematics Course".

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

I have self-confidence when it comes to mathematics

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

Studying mathematics in this “Transitional Course” makes me feel nervous.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I feel confident that I can add fractions with same and different denominators.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I am confident that I can figure out how much I will save if there is a 15% discount on an item I wish to buy.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I believe I know the decimal place value system very well.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

I believe real-life mathematics activities in mathematics class would help me learn mathematics with greater understanding

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

In general, the real-life mathematics activity in mathematics class are boring and waste of time.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I believe learning fraction, decimal and percent through online mathematics videos would be fun and interesting.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Sometimes I watch online mathematics videos at home to do the homework.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Showing videos in mathematics class would take away instruction time and it won't help me.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

POST - Survey Questions

What is your gender?

Male

Female

How old are you? _______________

What is your ethnicity?

African American

Asian

Hispanic

White

Other ____________

How long you have been living in the United States? ____________

Is English your first language?

Yes

No

What language did you speak in your home while growing up? ____________

What language do you speak in your home now? _______________

Do you currently have a job?

Yes

No

If yes, how many hours per week are you currently working?

1-20 Hours

21-40 Hours

Over 40 Hours

How long it had been since the last mathematics class?

1 year or less
2 years
3-5 years
More than 5 years

I believe I was good at solving mathematics problems in this "Transitional Mathematics Course".

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

I have self-confidence when it comes to mathematics

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Studying mathematics in this “Transitional Course” made me feel nervous.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I feel confident that I can calculate 20% tip on my restaurant bill without using calculator or any technology.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I am confident that I can figure out how much I will save if there is a 15% discount on an item I wish to buy.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I enjoyed the real-life mathematics activities in the transitional math class. It was interesting and helpful.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Real-life math activities in class helped me learn mathematics with greater understanding

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

It is worth doing the real-life math activities in future transitional courses.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

The real-life mathematics activities were boring and waste of time.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I enjoyed watching online videos on fraction, decimal and percent in mathematics class.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

I also watched online mathematics videos at home to do the assignment

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Watching videos in class encouraged me to learn new mathematics skills through online videos.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Showing videos in mathematics class takes away instruction time and it doesn't help me.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Appendix C: Observation Protocol

Classroom Observation Protocol

Purpose: The purpose of this observation is to learn more about students' involvement in the real-life mathematics activity and the class discussion on instructional video. The observation is one of the several sources used to collect data regarding the usefulness of the real-life mathematics activities and instructional video assisted instruction.

College	
Semester	
Course Title	
Mathematics Skill	
Instructor	
Number of Students (Enrolled in this course)	
Number of Students (During the observation)	

On a scale 0 to 5, 0 being the lowest and 5 being the highest, rate the following

The activity was implemented as planned	0	1	2	3	4	5
All or most of students were actively engaged in the activity	0	1	2	3	4	5
The students were respectful for each other's ideas and suggestions.	0	1	2	3	4	5

Students used several strategies to perform the task of the activity.	0	1	2	3	4	5
The goal of the activity was achieved.	0	1	2	3	4	5

Briefly describe the students' involvement in the activity.

Briefly describe the class discussion on the instructional video.

Appendix D: Interview Protocol

Interview Protocol

Date: _____________ Start and End Time: ___________ Interviewee: _____________

Thank you for volunteering for this interview.

The purpose of this interview is to learn more about students' involvement in the real-life mathematics activity and the class discussion on instructional video. The interview is one of the several sources used to collect data regarding the usefulness of real-life mathematics activities and instructional video assisted instruction.

This interview will be used to inform research on the use of real-life mathematics activity and instructional videos in mathematics classroom. I will be recording this interview to facilitate note-taking. Please note that all information shared in this interview will be treated with confidentiality. This interview will not influence your grades in the course. This interview session will last for 30 minutes but you may stop at any time if you feel uncomfortable.

Please let me know if you have any questions for me before I begin this interview.

Please tell me little about you. (Probe: high school, work…)

Your experience, feeling, and future goal related to mathematics.

Why is it important for you do well in this transitional mathematics course?

Real-Life Mathematics Activities

What did you like best about the three activities (Deal Alert, Gas Price and Land Owners) you did in class?

Which Activity was the best?

How do you think the activity has changed the way you learned mathematics in terms of time, strategies, trend, understanding, participation)

Would you recommend using hands-on activities in future transitional math courses?

Any suggestions to improve these activities?

Is there anything else about your experience with learning mathematics through hands-on activities that you wish to share?

Educational Video

What did you like the best about the three instructional videos (fraction, decimal and percent) you watched in class?

Which video was the best and more useful?

How do you think the instructional videos have changed the way you learned mathematics in terms of time, strategies, trend, understanding, participation)?

Would you recommend using videos in future transitional mathematics courses?

Any suggestions to use these videos more effectively in classroom?

Is there anything else about your experience with learning mathematics through instructional videos that you wish to share?

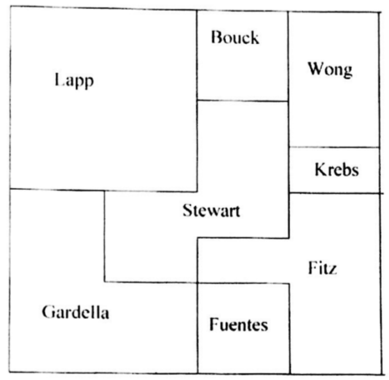
Do you have any questions for me?

Appendix E: Activity Worksheet for Adding Fraction

Land Owners

The land owners of section 18 in Tupelo Township are shown in the diagram below. (Reference text and revised worksheet). Each Section represents 1 (whole) square miles.

Section 18



Find the fraction **of the section** each land owner owns.

1. Lapp	5. Fitz
2. Wong	6. Stewarts
3. Krebs	7. Gardella
4. Bouck	8. Fentes

1. Suppose Fuentes buys Gardella's land. What fraction of a section will Fuentes own? Explain and show your work.

2. Fitz buys Krebs Land. What fraction of a section will Fitz own? Explain and show your work.

3. Stewart buys Wong's land. What fraction of a section will Stewart own? Show and explain your work.