Understanding Fractions in Grade 3

Submitted to Professor David Taylor

By Julie C. Hatch

In partial fulfillment of the requirements for the

Master of Science in Educational and Instructional Technology

National University

San Diego

February 23, 20XX

The Capstone Project entitled Understanding Fractions in Grade 3 is approved by:

Signature _____ Date _____
David Taylor, Associate Professor
Capstone Faculty Advisor, Sanford College of Education

I certify that this Capstone Project by Julie C. Hatch Understanding Fractions in Grade 3, in our opinion, is satisfactory in the scope and quality as Masters of Science project for the degree of Master of Science in Educational and Instructional Technology in the Sanford College of Education.

Signature_____ Date_____
George Beckwith, Ed. D., MSEIT Program Lead Faculty

Table of Contents

ABSTRACT

"Understanding Fractions in Grade 3" is an interactive, blended learning course designed to supplement traditional instruction in fractions for limited English-speaking third graders at Long Beach Unified School District (LBUSD). This course enhances 21st century literacy competencies that students are expected to attain to succeed in higher learning and career. With the availability of 1:1 Chromebooks at LBUSD and the adoption of the California Common Core State Standards for math, students will learn fractions - one of the most difficult math concepts for elementary school-aged children - in an interactive, technology-integrated environment and build conceptual, concrete, and procedural understandings of how fractions are represented and used in everyday life. This four-week course is designed with constructivist learning pedagogies in mind; particularly active and authentic learning, learning by doing, scaffolding, collaboration, and feedback. Using the ADDIE design model and delivered using Google Sites, the course uses full capabilities of the Google Suite for Education. The most important fraction concepts, best teaching practices, and engaging multimedia content from vetted online resources are combined in one concise website. This course offers flexible learning, differentiated instruction, room for mistakes and retakes, and a supplemental or intervention resource. To test the course for validity and purposefulness, a variety of usability and instructional evaluations were conducted with individuals who were subject matter experts, current third grade teachers, and current students during the developmental phase. Data from those evaluations found the online course to be easy to use, necessary, and an overall positive impact on a learner's understanding of fractions.

CHAPTER 1

Introduction

The Capstone project “Understanding Fractions in Grade 3” is a web-based course that introduces elementary students to the beginning concepts of fractions and is meant to coincide with Long Beach Unified School District’s third grade fractions unit. LBUSD’s elementary schools use Houghton Mifflin Harcourt’s *GO Math!* series; however, they follow the LBUSD’s created 2018-2019 math unit guide’s learning plan, “Unit 5 –Understanding Fractions as Numbers,” which is taught in the February timeframe.

"Understanding Fractions in Grade 3" is a four-phase (four-week), blended learning course; is delivered on Chromebooks; and is designed on Google Sites as an academic intervention supplement to teacher-led direct instruction, an independent study aid during Workshop (independent learning time), or at-home review. Verrett (2015) found that math blended learning programs positively affected the math achievement of K-12 students, particularly among socioeconomically disadvantaged students, because it “promotes active learning and motivation.” The course will build students’ understanding of fractions as they progress through each of the four phases.

The Long Beach Unified School District has made it a priority to transform instruction to better prepare students for a global society using a "systematic theory of improvement" (Zavadsky, 2016). This includes the district-wide purchase of 1:1 Chromebooks in 2017 and allowing teachers the flexibility to utilize the right resources to deliver the curriculum. Using Google Sites as a delivery method offers students additional practice at different times during the day, in the classroom, or at home. As an added benefit, students can revisit this course as an independent review resource for the high-stakes, yearly California Standards Based Assessment

Consortium (SBAC) test given to third graders in the April-May timeframe. The SBAC test is an adaptive online exam that California uses to measure the proficiency of the Common Core State Standards (CCSS).

The four-phase course will introduce fraction terminology as well as build conceptual, concrete, and procedural understandings of how fractions are represented and used in everyday life. It will follow the fractions progressions recommended by the National Council of Teachers of Mathematics (Englard, 2015) which provide a "roadmap that helps incorporate fractions into their general understanding of number and operations." In brief, the topic of each phase of the "Understanding Fractions in Grade 3" is as follows:

- Phase 1 – Understanding Fractions
- Phase 2 – Representing Fractions
- Phase 3 – Comparing Fractions
- Phase 4 – Fractions in Everyday Life

The course website is designed for interactivity by presenting engaging content using learning objects such as graphic models, text directions, video tutorials, links to proven fraction resources, practice problems with real-time feedback, and a variety of formative assessments to gauge student learning and interest. Critical thinking and problem-solving skills needed for 21st century success will be incorporated. By the end of this course, students are expected to achieve online proficiency with fractions at or above grade level standards.

Background of the Study

LBUSD provides teachers and students with up-to-date technology for use in all academic areas. Teachers are tasked with designing a curriculum, differentiated for the needs of the students in their classroom, that incorporates most of these resources. Currently, these are the

following technology resources that are aligned to the CCSS, vetted, and approved for LBUSD teachers to use in their math curriculum:

- ThinkCentral website by Houghton Mifflin Harcourt (https://www-k6.thinkcentral.com/). This portal offers interactive student editions of the *GO Math!* textbook, practice book, "Math on the Spot" and "Real World" videos, and SBAC practice book. Teachers report that although the resources on this site are extensive and offer multiple digital features, it is not user-friendly and practical as an everyday teaching tool. Teachers in the district were not trained to use the website to deliver lessons and are not required to follow the recommended textbook sequence. Therefore, a majority of teachers do not use the ThinkCentral website on a regular basis and rely on the print-bound resources; consequently, the ThinkCentral website as a learning tool is unfamiliar to many students.
- ST Math website by MIND Research Institute (https://www.stmath.com/). This program, also called JiJi Math, is a visual instructional program which builds deep conceptual understanding of math through problem-solving in a game-like environment. ST Math is a supplement that LBUSD teachers are required to use if the school purchased the license for it. The benefits are that students can use the program during Workshop and at home on their mobile devices or computers. Because this program has only visual and numerical content (no audio or text content available), it is not appropriate to use as the only math technology resource.
- SBAC Interim Assessment Blocks (IABs) and practice tests through California Assessment of Student Performance and Progress (CAASPP) web portal by California Department of Education (CDE) and Educational Testing Service (ETS)

(http://www.caaspp.org/). This website provides practice tests and interim assessments that are formatted similarly to the items on the SBAC tests. This website is primarily geared towards practicing the assessment and analyzing results. Teachers have to give a course login code to take the practice tests, and students can only take it at teacher-scheduled sessions. It is not used to introduce, teach, and practice academic content.

- Illustrative Mathematics website by Illustrative Mathematics (https://www.illustrativemathematics.org/). This is an online curriculum website offers teachers and students high-quality resources like math lessons, tasks, and games. It is geared towards teacher lesson planning rather than engaging students interactively online. Teachers present the videos and the tasks that are on their website and print out and make copies of the PDF worksheets for students to write on.

Statement of the Instructional/Training Problem

Grade 3 is the year when the fundamental concepts of fractions are introduced and developed; therefore, extensive modeling, practice, and feedback are necessary to achieve proficiency. Reinforcement and review of concepts should be available to students on a platform that they are familiar with regardless of time and place. One problem is students, particularly those who are limited English speaking, do not get enough exposure to the new vocabulary terms and thus, are unable to conceptualize how these terms relate to the real world within a limited time-frame.

Ludden (2017) describes fractions as one of the most challenging math topics for students to learn because most teachers who teach it in the United States are not proficient in it themselves. He goes on to say that using mathematical operations on numbers "less than a

whole" are hard for young students to conceptualize and that fractions are represented in multiple visual and numerical forms, which can confuse students. Presenting fractions in multiple contexts requires various types of manipulatives which makes preparing for a traditional lesson time consuming and cumbersome.

Checking for understanding is a necessary step in assessing where students are progressing and where they need help so that teachers can adjust instruction. However, it can be challenging to do this with regularity and consistency in the traditional lesson delivery context. Proficiency of fractions is measured through various formative means (e.g., exit slips, whiteboard check, quick checks, anecdotal notes, quizzes), however meaningful feedback and remediation may not be so immediate. For all these reasons, delivery of fractions instruction and assessment through digital means is a way to solve these problems.

Purpose

The purpose of the "Understanding Fractions in Grade 3" course website is to provide students with engaging, interactive instruction in fractions that would enhance the traditional textbook, worksheet, and math manipulatives lesson. As a blended learning course, it will be tailored to class needs as an intervention supplement to provide otherwise disadvantaged students with "skills, knowledge needed to close the academic achievement gap and succeed in a larger academic and social context" (Verrett, 2015). When students are proficient in understanding fractions, they can take this knowledge and apply it to real-world problem solving in the upper grades and life.

"Understanding Fractions in Grade 3" takes the most important concepts and best teaching practices from the technology resources and combines them into one concise site that it is easily accessible and easy to navigate for this particular unit. According to Zavadsky (2016),

LBUSD's superintendent, Chris Steinhauser explains, "When new approaches come in, we keep the best of the old and enhance it with the new, and then assess for effectiveness." This approach allows teachers to refine and improve the resources given to them and tailor them to the needs of the students. The course website will:

- Enable teachers to provide links to the website quickly through Google Classroom.
- Permit teachers to customize or modify content presented to students.
- Follow the LBUSD unit guide's learning plan for Unit 5.
- Help students locate information quickly with easily navigable formatting, tabs, and links.
- Provide students interactive tutorials, practice problems, and formative assessments that they can revisit at various times of the day and in different environments.
- Cover items and tasks that not only will be presented on the SBAC test, but in real world situations. Students will learn fractions through engaging content presented in a variety of digital forms.
- Allow students to construct an understanding of fractions through a series of scaffolded lessons, practice, tasks, discussions, and assessment feedback.
- Give students timely feedback on their progress and enable them to review concepts where they need more help with.
- "Understanding Fractions in Grade 3" aims to develop an understanding that fractions are numbers, they represent a part of a whole, and that they take many forms, fulfilling California CCSS's domains, which focuses on the following two content strands:
    - Number and Operations - Fractions

        - 3.NFA.1 – Understand a fraction as 1/b as the quantity formed by 1 part when a whole is partitioned into b equal parts; understand a fraction a/b as the quantity formed by a parts of size 1/b.
        - 3.NFA.2 – Understand a fraction as a number on the number line; represent fractions on a number line diagram.
        - 3.NF.3 – Explain the equivalence of fractions in special cases and compare fractions by reasoning about their size using visual fraction models, number lines, and comparison symbols.
    - Geometry
        - 3.G.A.2 – Partition shapes into parts with equal areas and express area of each part as a unit fraction of the whole.

In addition, CCSS Math Practice 5, which focuses on engagement, states that "Mathematically proficient students are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts." A needs analysis has determined that digital technology can integrate content knowledge and student engagement with the content. In accordance with the Framework for 21st century learning (P21), students need to be able to interact, conceptualize, and improve their procedural fluency with fractions using technology, mainly because 21st century skills and today's standards for mathematical practices require students to use appropriate tools strategically in order to solve problems (P21 Framework, 2016). To do this, they need to access the content, practice items using a variety of strategies, and receive meaningful feedback of their progress.

The lessons in “Understanding Fractions in Grade 3” are intentionally constructed and scaffolded using the *CCSS for Mathematics* and *Progressions for the Common Core State Standards in Mathematics* as a guide. By purposefully integrating learning objects, the lessons address multiple learning styles, encourage engagement and collaboration, and increase achievement of core content. The learning objects on this course website fulfill targeted learning objectives and is a proper tool to address this need.

Delimitations

Audience. The target audience for the course website, "Understanding Fractions in Grade 3", will be LBUSD students in Grade 3, approximately 8-9 years old. These users are digital natives, users of technology raised on video games, smartphones, and computers. In their current academic setting, they have been exposed to a variety of lessons and assessments delivered on Chromebooks for two years. However, 68% of them are considered socioeconomically disadvantaged (Zavadsky, 2016) and there is a pressing need for instructional programs to serve to meet their needs. They have been taught the concept of partitioning shapes (up to fourths) into equal pieces in Grade 2. Therefore, they have some keyboarding skills, are familiar with Google Suite for Education, and have a rudimentary understanding of basic fraction terms. Students will use the course website as a supplemental intervention resource to whole group direction instruction. Students will also use this website during independent work time at school and can also access it at home on their school district Google Classroom accounts.

Technological. Students will be using LBUSD issued Chromebooks which they can access within school hours on district enabled WIFI. Students can access the course off-campus provided they log into the LBUSD student portal with their district-issued user ID and password, which will give them permissions to enter Google Sites.

Human. To use this course effectively, teachers will have to intentionally assign online coursework to coincide with direct instruction. If this course is used as a review of concepts, then students can use it during their independent work time in class or off-campus.

Financial. This course is offered at no cost to the students and LBUSD instructors as it is a supplement to the LBUSD curriculum and provided on its Google Suite for Education subscription.

Definitions

For the purposes of understanding this course, the following words are defined:

Comparing fractions. The process of determining if two or more fractions are greater than, less than, or equal to each other. The symbols <, >, and = are used.

Denominator. The number below the line in a fraction. Denotes how many parts the whole is divided into.

Equal parts. The division (or partition) resulting in identical parts. Having the same portion, shares, division, piece, or segment of a whole.

Equivalent fractions. Two fractions that express the same part of a whole. There is a number by which both the numerator and denominator of one fraction can be multiplied or divided to yield an equivalent fraction. 1/4, 2/8, and 3/12 are all equivalent fractions.

Fraction. A number that names part of a whole or part of a group. For example, 5/6. In a fraction, the top number tells how many equal parts are being counted. The bottom number shows how many equal parts are in the whole or the group.

Fraction progressions. The sequence of learning a fractions topic across a number of grade levels. They explain why the Common Core State Standards for fractions are sequenced

the way they are and point out the cognitive difficulties and pedagogical solutions (Institute for Mathematics and Education, 2007).

Improper fraction. A fraction in which the numerator is greater than or equal to the denominator. For example, 9/4.

Mixed number. A whole number and a fraction. For example, 2-1/4.

Number line diagram. A diagram of the number line used to represent numbers and support reasoning about them.

Numerator. The number above the line in a fraction. Denotes the number of parts of the whole that are being taken.

Partition. Separate, divide, split.

Proper fraction. A fraction in which the numerator is less than the denominator. For example, 2/5.

Unit fraction. A fraction that names 1 equal part of a whole. It has 1 as its top number. For example, 1/6 is a unit fraction.

Visual fraction model. Representation of a fraction using graphics instead of numeric notation. For example, a tape diagram, number line diagram, bar model, area model, fractions of a group, or closed figure model.

Whole. All the parts of one shape or group. For example, the numbers 0, 1, and 2 are whole numbers.

Summary

"Understanding Fractions in Grade 3" is designed to provide a useful and practical digital resource that combines the most essential fractions topics and practices from print and technology resources in one course website. Engaging content, instruction with fractions

progressions in mind, practice, assessment, and interactivity are delivered using Google Sites, which has other Google Suite for Education applications integrated into it, as well as links to other web sites. During the four-phase course, students will explore fractions content and vocabulary through slide presentations and video, practice problems and tasks, and take weekly quizzes so that they can monitor their progress. The intentional design of this course will provide students a supplemental resource that will address multiple learning styles and a technologically rich learning environment that will encourage increased achievement in fractions.

CHAPTER 2: Review of the Literature

Introduction

"Understanding Fractions in Grade 3" gives students access to an online curriculum of learning objects that are sequenced according to researched developmental progressions recommended by the National Council of Teachers of Mathematics (NCTM) and the Common Core State Standards for Mathematics Initiative (CCSSM Initiative). The course has its roots in traditional fractions instruction, and the addition of the technological component as an intervention attempts to solve the myriad of limitations that hinder students' conceptual and procedural understandings of fractions.

A review of the literature focuses on the relevant research that "Understanding Fractions in Grade 3" is based on. First, this chapter describes the historical background, more specifically the problems and the attempted solutions of fractions instruction, as it migrates from traditional to an online delivery platform. Next, research on the theoretical framework of online learning combined with conventional practices in math instruction is presented as digital natives and teachers transition towards their understanding of math in the context of a blended learning environment. Finally, literature on current research and development, such as adding collaborative discussions and the use of virtual manipulates, are investigated.

Historical Background

Understanding fractions is the basis of higher mathematics and science learning. Leading studies assert that proficiency in fractions is the "gatekeeper" to higher level concepts like algebra, which is a critical step towards "upper level, college, and career success" (Booth & Newton, 2012; Krowka & Fuchs, 2017). Failure to learn fractions can lead to negative consequences in professional careers (e.g., health, medicine, construction, and financial) because

such understandings are crucial to life and livelihood (Ross, Sibbaldt, & Bruce, 2009). It is found in a comprehensive review of literature that educators and researchers around the world agree on one thing: understanding fractions is the most challenging math concept for elementary students to master (Misquitta, 2011).

Problems with Fractions Learning. Considerable research has found that there are various reasons why fractions understanding is challenging. Formally introduced in third grade, the addition of fractions interferes with younger students' initial understanding of whole numbers and how they work (Krowka et al., 2017). In other words, students at this age are beginning to compute with whole numbers and understand their relationship with each other on a number line. When adding the concept of "parts of a whole," a new level of mathematical representations is introduced, thus making fractions more confusing. Written notation (e.g., text and word); numerical and visual representations (e.g., parts of a shape, parts of a group, number line, bar models); new terminologies (e.g., numerator, denominator, parts and pieces, and equal shares); computing rules, procedures, and strategies; relating fractions to real-world, meaningful context; and retention of all these concepts are proven difficult (Bottge et al., 2009; Krowka et al., 2017).

For teachers, especially those new to teaching, the gathering and managing of materials (e.g., textbooks, worksheets, presentation material, and manipulatives) and time constraints and schedule limitations are significant issues. In addition, the execution of differentiated and engaging fractions lessons that are appropriate for the many types of learners there are in the classroom is a complicated and considerable organizational undertaking (Booth et al., 2012; Bruce et al., 2009). Luddon (2017) found that most teachers do not have a firm understanding of fractions concepts themselves, much less how to teach children.

Solutions to the Fraction Conundrum. Numerous studies suggest that online learning, combined with other teaching strategies, provides an effective intervention and enrichment support for fractions. Online learning aligns with the CCSSM which state that technology should be integrated in all curricular subject areas so that "all students should have the opportunity to learn, ensure success in their lives outside of school, and be afforded with the accommodations necessary to participate in learning activities in school" (Bottge, Cohen, & Choi, 2018). Musti-Rao (2017) found the following in his research on integrating technology with classroom practices:

> Given the achievement gaps between various groups of students in schools today, it is imperative that teachers implement interventions that are not only effective and have an evidence-base, but also are efficient, that is, interventions that require less effort, time, or resources but yield the desired outcomes. When integrated meaningfully with curriculum and instruction, technology can be beneficial to teachers. This is especially true in schools where the achievement gaps are wide, and students are struggling to meet grade-level requirements. Technology is well suited to supplement core classroom instruction by providing students with additional review and practice. (pp. 131-132)

Research confirms that integrating technology mitigates the cognitive and organizational overload of students and teachers, especially for a difficult concept like fractions. Bruce et al. (2009) point out that in a busy classroom, technology-based resources can fix student misconceptions about fractions and "provide the sequencing and scaffolding teachers might have difficulty providing." They presented studies that show that "high-quality professional development, especially in the appropriate use of multimedia-based units" can help improve students' achievement by providing them visually engaging tasks which "evoked genuine student

interest." For teachers, virtual fraction models can be "as effective as physical models while also being more efficient and easier for teachers to implement" (Gresalfi, Rittle-Johnson, Loehr, & Nichols, 2017).

Blended learning provides a flexible means of face-to-face instruction and online learning. When properly constructed and integrated with traditional classroom instruction, it can personalize learning so that students pace themselves, particularly those that need more time or practice on a particular concept. Hensberry, Moore, & Perkins, (2015a) found that "intentional inclusion of multiple, dynamic, linked representations supports students to develop their conceptual understanding of fractions." Online delivery of instruction allows for both flexible interaction and targeted instruction with learning objects and tasks which can generate interest, strengthen procedural skill, increase positive response towards learning, and deepen conceptual understanding which in turn produce academic success (Hensberry et al., 2015a). Also, an effective online course introduces concepts using various modes of learning, provides a variety of practice in the form of digital games or tasks which allows for errors and opportunities to correct them, and gives immediate and meaningful feedback from formative and summative assessments.

Theoretical Framework

Blended Learning. There is ample research to support that 21st century skills and knowledge and the challenges that students face in the increasingly competitive society demand for a transformation in the way students are taught math in schools. Many school districts recognize this and have responded by investing in technology and professional development so that teachers can blend technology meaningfully into their instruction. This Capstone project is outlined in the context of the blended learning framework because it effectively addresses the

way two main elements of 21st century learning: how learning is differentiated and how visual models are presented.

Blended learning gives the teacher the power to ensure the right type of instruction is geared towards the student's learning needs. Ross et al. (2009) studied teachers and students who used technology to differentiate fractions instruction and found that teachers assigned online fractions instruction to students who were performing poorly and were having difficulty with whole-part fractions concepts. They concluded that the inclusion of graphics and interactivity is motivating, thus creating "buy-in," and that students overcame their negative attitudes towards learning. Yakubova, Hughes, & Hornberger (2015) found that the use of video modeling to fraction problem solving proved useful as an intervention to students who had learning difficulties, such as autism spectrum disorder. They found that video-based instruction "can be an equalizer for students with disabilities and enable students to engage in learning at an individual pace with opportunities for repeated practice (Yakubova et al., 2015). Zahner, Velazquez, Moschkovich, Vahey, & Lara-Meloy (2012) found that Latino/an English Language Learners (ELLs) using online math technology that is enriched with language opportunities and visual representations exhibited learning gains by learning complex math concepts and improving mathematical discourse.

Understanding fractions are highly dependent on multiple visual representations, both in form and quantity. Blended learning allows for complementing concrete, physical manipulatives with multiple graphics, video with audio, virtual manipulatives, and interactive simulations that students can engage with. For example, students can see visually see how wholes can be divided into parts, or equal shares, in an instant. Yakubova et al. (2015) found that video modeling provides a "video recording of a target skill with step-by-step explanations." Students can then

view the video clip multiple times, at an individual pace, until mastery of the task is achieved. Bottge et al. (2018) found that problem-solving situations involving fractions can be illustrated by video more effectively than text-based questioning. They note that positive academic outcomes resulted when situations were presented in a meaningful context, and video is just the medium to do that. Also, Hensberry et al. (2015a) research confirm that visual representations, such as virtual manipulatives and interactive simulations, increased procedural and conceptual understanding as well as overwhelmingly positive attitudes towards fractions instruction. Hoch, Reinhold, Werner, Richter-Gebert, & Reiss (2018) conclude that regular paper-based textbooks do not provide the features students need to understand the way fractions should be understood nowadays. In alignment with Jerome Bruner's modes of representing mathematics and problem solving (Bruner, 1977) and subsequent iterations of these modes, Hoch et al. (2018) studied an interactive fractions textbook incorporated enactive representations (content explored through actions), iconic representations (image based), and symbolic representations (abstract). The online textbook is an example of online learning that attaches visuals (like manipulations, images, and symbolic representations) to a task and solving given tasks with these visualizations helps students master the concept of fractions.

The review of the literature supports that blended learning provides a learning environment that can assist students, regardless of their learning issue or preferred learning modality, understanding fractions in depth and breadth. Online learning, combined with traditional face-to-face learning, makes differentiation of instruction easier for the teacher and student and the use of multiple representations of a difficult concept like fractions possible. "Understanding Fractions in Grade 3" relies on the blended learning framework that includes differentiated learning and multiple visual representations as two of its essential elements.

Current Research and Development

Collaborative Discussion. Technology instruction should not be used in isolation as a "one-stop-shop" intervention. Meaningful discourse, whether whole class, small group, and one-on-one (with teacher or peers) is still a proven strategy in constructive concept formation. Hensberry et al. (2015b) found that "teacher facilitation with authentic conversation needs to be integrated with online fractions instruction because of the complexity of the concepts and language." During the implementation of this online course, direct instruction, collaborative discussion, and flexible group instruction are still needed.

This course also takes advantage of Google Groups, which is the collaborative online discussion forum that is available through the Google Suite for Education. Students can post questions and answer their peers' questions on an asynchronous discussion board embedded on Google Sites. According to Rodgers (2016), written responses allow time for students to reflect and synthesize information before writing allowing for a more complex thinking process. It also establishes a community of learners and "minimizes the risk that someone will dominate a conversation." Students will also use the Zoom application, a meeting site, to synchronously chat with classmates and teacher during a specific time period. This is an example of 21 century learning that students can use within "Understanding Fractions in Grade 3." While numerous studies researched online discussions in upper grades, higher education, and business organizations, there is little to no research on the effects of online discussions in the lower grades.

Virtual Manipulatives. Virtual manipulatives applications are available for free or at a cost to teachers and students. Virtual fractions manipulatives are visual representations of fraction models that can be dynamically manipulated on the computer screen. "Understanding

Fractions in Grade 3" uses games and links to a virtual fractions manipulatives application developed by The Math Learning Center (http://www.mathlearningcenter.org/resources/apps).

Fractions instruction has always been taught through fraction models, whether they are drawings on paper or physical manipulatives (e.g., pattern blocks, fraction bars, geoboards/rubber bands, etc.). Mendiburo & Hasselbring (2014) compared the difference between virtual and physical manipulatives and discovered through their research that there were three significant difficulties with physical manipulatives: (1) classroom management and organization, (2) structuring, monitoring, and assessing the use during a lesson, and (3) connections between the manipulative to the mathematical symbol or procedure. With virtual manipulatives, they found organizational and pedagogical advantages such time-efficiency and more exposure to practice exercises and games led to higher achievement scores on assessments.

Reimer & Moyer (2005) found that there was a "statistically significant improvement in conceptual and procedural knowledge when using virtual manipulatives" because the virtual manipulative apps "gave students immediate feedback, were easier and faster to use and enhanced students' enjoyment while learning mathematics." They found virtual fractions manipulatives also gave students chances to make mistakes and be aware of their misconceptions about how fractions work. Additionally, multiple representations can be presented which can be beneficial for any learner regardless of speed, learning issue, and time limitations. However, learning with virtual manipulatives still has to be coupled with explicit instruction so that the connections between the abstract symbols and fraction concepts can be made.

Summary

The review of the literature demonstrates that learning, practicing fraction concepts, and assessment online for immediate feedback is needed for 21st century teaching and learning. The

research shows that the carefully sequenced components and pacing of the online course "Understanding Fractions in Grade 3" provides students with learning activities and tasks that have been proven successful in fractions concept and procedural formation. In addition to traditional direct instruction, this course can be used as an effective intervention or supplemental resource for students who need extra reinforcement/clarification, require additional time to practice or have learning difficulties. Technological advances, 1:1 Chromebooks, and high-speed Internet access, have given LBUSD students and teachers path towards 21st century learning goals.9

CHAPTER 3: Project Design

Learning Theory

One-to-one technology devices are prevalent in America's 21st century classrooms and are challenging teachers to incorporate them into pedagogical practice (Sutton, 2015). Today's elementary students are digital natives who are expected to use technology in mathematics instruction, as recommended by the NCTM, CCSS Initiative, and the Framework for 21s century learning (P21). A transformation in education is required to address the needs of a globally-connected, information-rich society. Teachers are not the only means to acquire such information because information can be found anywhere online. Therefore, a pedagogical shift in teaching and learning need to happen so a teacher could purposefully and intentionally incorporate 21st century skills in their blended learning curriculum. The lessons, activities, and assessment options offered by the online course "Understanding Fractions in Grade 3," are rooted in constructivism.

Constructivism. Constructivism is a learning theory that posits that new learning occurs when cognitive processes are shaped by the interaction of content and social activities. The four central principles of constructivist learning pedagogy are (1) active and authentic learning, (2) learning by doing, (3) scaffolded learning, and (4) collaboration (Harasim, 2017, p. 61). Lev Vygotsky (1978), a leader in the social constructive perspective of learning, believed that "with new technologies come new human capacities and a need for new approaches to learning." The online course "Understanding Fractions in Grade 3" aims to deliver content with the most available technologies and encourage students to construct fractions concepts by engaging and creating, collaborating and communicating, monitoring progress, and remediating in ways that are personalized, flexible, and instantaneous and within what Vygotsky termed the students' Zone of Proximal Development (ZPD). According to the theory:

> The ZPD of a child is the distance between her actual developmental level as determined by independent problem solving and her level of potential development as determined through problem solving under the guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86)

Constructivism promotes curiosity and knowledge that is meaningful to the individual (Harasim, 2017). Students inquire, explore, practice, collaborate, receive and react to the feedback of others, and create a result in a virtual, yet integrative learning experience. Norton & Ambrosio (2008) examined mathematical development in fractions using the ZPD theoretical framework and found that students must operate within this zone to construct meaningful learning. Students benefitted from online fractions instruction when students were had regular access and were comfortable with computers, the content was perceived as being useful, instructions were clear, and the theme was fun or motivating (Bruce et al., 2009). In addition,

Bruce et al. (2009) found that if an online fraction activity was outside the student's ZPD (whether too easy or too difficult), the student may become disengaged and frustrated with the activity. Therefore, a teacher must plan sequential and scaffolded activities that help with the construction of concepts. "Understanding Fractions in Grade 3" intends to do just this. The course will expose students to the processes and skills that are developmentally appropriate according to the *Progressions Documents for the Common Core Math Standards* for a third grader's ZPD. Tasks and activities are framed within a context that is appropriate for the students' developmental stage of learning. This learning is scaffolded until expertise in the domain is achieved.

The online course supports the social constructivist theories laid out by Vygotsky's Zone of Proximal Development. The learning activities and tasks are developmentally appropriate and scaffolded allowing students to construct their meaning of fractions concepts through the use of learning objects such as a collaborative discussion board and virtual manipulatives.

Project Design

ADDIE Model. The designer of the online course "Understanding Fractions in Grade 3" used the structure of the ADDIE model of instructional design. The acronym ADDIE stands for Analysis, Design, Development, Implement, and Evaluate which describe a conceptual and iterative development process rather than specific steps to instructional systems development (ISD) (Molenda, 2015). For this course, ADDIE was the ideal model to use for this course because it is learner-centered and allows for phase overlap, flexibility, reanalysis, and design and development modifications based on learner needs (McGriff, 2000; Bates, 2014). Bates (2014) found that is heavily used in high quality online courses because of its proven benefits: "good quality design, clear learning objectives, controlled workloads for faculty and students,

integrated media, relevant student activities, and assessment strongly tied to desired learning outcomes." There are many advantages to this ID model for the designer as well. Piskurich (2006) determined that ADDIE is cost, time, learning, and training-effective as well as provides consistency of design procedures which boosts the quality of the project.

Procedure

The following Procedure section describes the ADDIE model phases in brief along with the method the designer took to bring this course into fruition. Do consider that these phases overlap and that multiple iterations of the project have been made and at this time still in progress.

Analysis. This first step in the ADDIE process requires careful examination of the variables needed to be considered for the course. These variables included the characteristics and the specific needs of the learner, the technical and content resources necessary for the project, the instructional goals and desired learning outcomes of the course, and the time and human assets required for all phases of the ID process (Chappell, 2018).

During the analysis phase, designer of this project found that third grade students of the Long Beach Unified School District need engaging, interactive instruction in fractions that would enhance the traditional textbook, worksheet, and math manipulatives lesson and provide enrichment and intervention to a variety of learners. A needs analysis revealed that existing technology resources for understanding fractions were disparate, and students needed a site that integrated important concepts and proven learning objects tailored to their learning needs. The instructional goals coincide with the Long Beach Unified School District's third grade fractions unit, "Mathematics Unit Plan for Grade 3: Unit 5 – Understanding Fractions as Numbers Unit Plan." The instructional goals are that students will be able to

- name a fraction and its parts by determining the number of equal parts of the whole (i.e., circle, rectangle) and name the shaded/unshaded parts in fraction terminology (numerator, denominator) with 70% or more accuracy.
- use their understanding of fractions to represent fractions using visual models (number line, 2-dimensional closed figures, bar model, group of things) and numerical notation with 70% or more accuracy.
- determine fractional equivalence by using visual models (fraction circles, bar models, groups of things) and numerical notation. Problems will include fractions with like denominators and fractions with like numerators. The learner will use specific strategies and math symbols (<, >, and =) to compare, order, and model equivalent fractions with 70% or more accuracy.
- solve a variety of real-life fraction word problems and performance tasks by choosing the most efficient strategy and using the UPS✓ (Understand, Plan, Solve, Check) problem solving procedure with 70% or more accuracy.

The desired learning outcomes for the course are addressing multiple learning styles, encourage engagement and collaboration, and increase achievement of core content.

Design. According to McGriff (2000), the design phase involves "using the outputs from the analysis phase to plan a strategy for developing the instruction." During this phase, an outline of how to reach the desired learning outcomes is created. A framework, such as a site map or bulleted list, allows the designer to see if the learning platform, learning objects, resources, and tools used align to the desired learning outcomes.

For this online course, the designer determined a four-week course aligned with the four instructional learning goals was needed. A site map using the horizontal Hierarchy chart in

Microsoft Word's SmartArt feature was used to sequence and provide a visual representation of the course structure (Appendix A). Google Sites was chosen as the most practical and flexible delivery system for this course since it is available through the Google Suite for Education, which LBUSD subscribes to and has made available to all teachers and students in the district through 1:1 Chromebook devices. Google Sites has all the capabilities to deliver the contents of the course such as ready-made templates and themes, intuitive navigation tools, integration with all Google applications (e.g., YouTube, Google Drive, Google Forms, Google Slides, Google Groups, etc.), embed and link features for a variety of multimedia content and HTML code, dynamic web page optimization, and collaboration and sharing features.

Development. The development phase is when content such as the storyboards, scripts, lessons, multimedia content, formative and summative assessments, web page layout, and site navigation is assembled, authored, created, and produced.

In developing the site navigation for this course, the course designer deemed that it must be "usable" to anyone who uses it. According to Krug (2014), a web site is usable when "a person of average (or even below average) ability and experience can figure out how to use the thing to accomplish something without it being more trouble than it's worth." The navigation followed Krug's three laws of web and mobile usability:

1. Don't make me think; all the information on the web page should be self-evident;
2. Regardless of how many times one clicks, each click is a mindless, unambiguous choice. Each click must be useful and serve a purpose; and
3. Omit needless words. Get rid of half the words on each page, then get rid of the half of what's left.

The course web page layout maintained a consistent theme and utilized CRAP design principles of contrast, repetition, alignment, and proximity. Williams & Tollet (2006) detailed these principles in *The Non-Designer's Web Book*, 3rd ed.:

1. Contrast – a visual technique that makes important elements stand out and less important elements muted;
2. Repetition – visual elements are repeated to develop a sense of organization, unity, and consistency;
3. Alignment – visual elements are connected to create a visual flow, so the site is clear and organized;
4. Proximity – visual elements that are related are grouped to organize information and reduce clutter.

When designing the course layout and each web page of "Understanding Fractions in Grade 3," the designer used Google Site's Impression theme, ready-made templates called "Layouts," and site hierarchy web page structure called "Pages." Google Sites also offers some customization features, but there are several limitations because of standardization (e.g., sizing of text and placement of elements). Top navigation tabs were chosen to highlight the main sections of the course web site so that every page is accessible from any web page. Additional buttons on the page itself provide links to the most important web pages. Each web page was purposefully designed so that each section follows the left-right, top-down navigation. The weekly web page sections include an introduction, objectives, content standards, video, learning activities (lesson, practice, quiz), and bottom links to print resources, discussion board, help, and the home page.

Content and visual elements that were already developed by others were carefully chosen for their effectiveness towards the learning goal and potential relatability with third grade

learners. The designer also authored text or created other visual elements needed but not readily available for use. In this respect, the designer can customize the learning experience to the learner's needs.

Implementation. During the implementation phase, the actual delivery of the course in real world context occurs (Bates, 2014). Alpha testing volunteers were fellow National University Capstone project members who were subject matter experts (SMEs), curriculum and instructional designers, and current full-time educators. They were given a link to the full web site, completed a reactionary survey, and provided feedback on the usability, web design, navigation, visual elements, and learning activities.

Evaluation. The process of determining the adequacy of instruction (McGriff, 2000). According to Bates (2014), this phase involves collecting feedback and data to identify areas that need improvement or modification. The details of the evaluation phase are discussed in Chapter 4.

Ethical Considerations

It should be noted that volunteer test subjects used for alpha testing were not put under undue pressure to participate, nor was any financial compensation or personal favors given for their cooperation in testing "Understanding Fractions in Grade 3." Alpha testing requires the designer and test subjects to review the earliest renditions of the course to ensure that course content matches the designer's scripts and that the course functions correctly (Horsley, 2012). The test subjects were subject matter experts, curriculum and instructional designers, and current full-time educators.

Summary

"Understanding Fractions in Grade 3" was created in response to the pedagogical shift in teaching fractions where teachers must incorporate 21st century technology ideas to help students prepare for a global, hyper-connected world and careers that require these skills. The design of this online course was based on the Zone of Proximal Development (ZPD), a constructivist concept that states if a student is learning within his or her ZPD, providing appropriate assistance, will give the student enough of a "boost" to achieve the task. It also supports the ideas of scaffolding tasks, collaboration, and interaction with technology (e.g., multimedia elements, virtual manipulatives) to construct his or her understanding of fractions.

The designer chose the ADDIE model of instructional design for its flexibility and iterative processes and Google Sites to deliver the course. These choices allowed the designer to rapidly design the structure of the course, gather and organize course content, go through multiple revisions, allow for evaluation, and make sure the learning objectives and instructional goals are met at each phase.

CHAPTER 4: Project Evaluation and Discussion

To determine the adequacy of instruction of "Understanding Fractions in Grade 3," instructional evaluation and usability evaluation surveys were implemented during the early development stage of the ADDIE instructional model of design. This chapter synopsizes the evaluation instruments chosen for this online course and the resultant data that followed. Test subjects were recruited based on their subject matter knowledge, age level, and technical expertise.

Project Evaluation

When designing a website for learning academic content, the site not only needs to be appealing, engaging, and appropriate for the student. It needs to contain all the required information for users to achieve the learning objectives for which they came to the website for. The usability evaluation (UE) measured the usability and functionality of the website design and navigation, and the instructional evaluation (IE) measured the effectiveness of the website in terms of the instructional goals met. Both UE and IE were conducted in a span of one week, using the same test subjects.

Usability Evaluation Explained. If the website does not have "usability," then users may become frustrated with the learning process and will not see the purpose of it as a learning resource (Myers, 2015). Usability expert Steve Krug (2014) defines something "usable" as something, "Pretty simple. If it's usable…a person of average (or even below average) ability and experience can figure out how to use the thing to accomplish something without it being more trouble than it's worth." Ballard (2010) found that instructional designers (IDs) should aim to design a website that has high usability so that it will provide users a satisfying and motivating learning experience which will ultimately lead to academic success.

Usability.gov (2018) found that to determine if a website helps achieve learning objectives and of users are satisfied with the process, a usability evaluation (UE) should be conducted. A UE is a process where IDs use a variety of methods to gather feedback from users about an existing or new site to inform the design and revision process. Myers (2015) says that usability evaluations should, "focus on the student's actual experiences as they interact with the educational content, menus, tools, navigation, layout, and screen sequences."

The evaluators who were part of the usability evaluation determined if the "Understanding Fractions in Grade 3" course website was appropriate for inner-city Long Beach third graders who are learning the concept of fractions for the first time. The website was created using Google Sites, which is part of the Google Suite for Education, a collection of applications that the students have access to on their Chromebooks. Table 4.1 describes the informational categories and the specific learner characteristics of the target user.

Table 4.1

Target User Profile

Information Categories	Learner Characteristics
1. Education	• Students are in the middle of their 3rd grade year.
2. Cultural Background	• Students born in the U.S. and have Hispanic, African American, Cambodian, and mixed-race backgrounds.
3. Age	• Users range in age from 8-10.
4. Sex	• Roughly equal number of girls and boys.
5. Prior knowledge of the topic area	• Most have retained basic knowledge of a whole, half, and quarter from Grade 2. Understanding fractions, as required by the California Common Core State Standards for mathematics in this breadth and depth, is limited.
6. Attitudes toward content.	• User attitude toward mathematics ranges from neutral to positive.
7. Attitudes toward potential learning preferences	• User attitude towards learning using technology and online delivery is mostly positive.
8. General learning preferences	• Students prefer a balanced learning style. They are used to teacher-led direct instruction integrated with

	technology. Students can do independent practice on a variety of Chromebook applications.
9. Work product experience	• Students are familiar with Google Suite for Education and navigating the Internet.

Evaluators. The following persons were chosen to evaluate the usability materials for "Understanding Fractions in Grade 3":

- Danny Sein – LBUSD Teacher, Grade 3 – Subject Matter Expert (SME), Instructional Designer (ID), teacher
- Bruce Blacklock – LBUSD Teacher, Grade 3 – SME, ID, teacher
- Eric Hatch – Long Beach City College Student – math major, private math tutor
- Three current 3rd grade Lincoln Elementary students – novice learners

Usability Evaluation (UE) Instruments. Krug (2006) explains that an ID should have others outside the design process try the website site because having a new set of eyes gives "a fresh perspective on things." Krug also recommends that usability testing should be done early and often with at least three participants in each round so that the ID can identify and fix any usability problems and improve the website. The UE plan will consider the ideas in Jakob Nielsen's *Usability Engineering* (1993), which identifies five major components of usability: learnability, efficiency, memorability, errors, and satisfaction. The following tests, outlined by Rubin and Chisnell's *Handbook of Usability Testing*, Second Edition (2008), will be used as part of the UE:

- ***Exploratory (formative) testing*** – This test is administered in the design phase of the ADDIE process using a collaborative interaction method. The purpose of this test is for users to examine the preliminary design concepts and basic functionality of the

course website and for testers to observe and record the reactions of the users. The test instruments that will be used are a test invitation, test script, test session directions, permission form, and an observation form. During exploratory testing, the user will be presented with a mostly horizontal representation of the prototype and be able to "think aloud" the thought process of "walking through" the site while performing specific navigation tasks. Screencastify, a screen and audio recording Google Extension, will be used to capture and record data. The tester will also collect online data using paper forms or Google Forms.

- ***Assessment (summative) testing*** – When approximately 70-80% of the course website is functional (during the development phase), an assessment test will be conducted which will assess whether a user can "perform full-blown realistic tasks and identify specific usability deficiencies" in the website (Rubin, 2008). Although the interaction between the user and the tester is lessened, the user is still encouraged to "think aloud" as certain behaviors are being collected. Screencastify will also be used to record screen movements and audio. Paper forms or Google Forms will be used to collect tester and user data. Quantitative data that measures if a particular task is accomplished is collected and analyzed. The test instruments used during this phase are the test session script (see Appendix B.1) and test directions script (see Appendix B.2), observation form (see Appendix C), post-session questionnaire (see Appendix D), and consent to record (see Appendix E).
- ***Validation (verification) testing*** – At the end of the development phase but before implementation, a validation test will be conducted to measure the usability of the website as it pertains to the efficiency and effectiveness of fulfilling the stated

learning objectives of the course and as it compares against well-regarded standards. (Rubin, 2008). This test also evaluates how all the components, from start to finish, work together and most importantly, attempts to find any significant flaws before the website is released. The test instruments used in the phase are the test invitation, test script, test scenarios, permission form, and post-session questionnaire. Screencastify and Google Forms (or paper forms) will be implemented as data collection tools in this phase as well.

Instructional Evaluation Explained. An instructional evaluation (IE) is an analytical process to determine whether the design, contents, and delivery of an online course were effective, streamlined, and the instructional goals were met. An IE meant to answer the questions, "Did it work? Did your training do what it set to do? Was it any good?" (Piskurich, 2006, page 267). Piskurich (2006) strongly advises that instructional designers perform an IE before the actual launch of an online course to know whether the training designed was successful in meeting individual and organizational instructional goals. In addition, the IE analyzes the online course's cost-effectiveness as well as the learners' likability and engagement with the content and activities. The resulting information is valuable, as it allows the instructional designers to reflect and refine the online course for maximum efficiency before actual implementation. This IE plan evaluates the Capstone project, "Understanding Fractions in Grade 3," an online course that introduces elementary students to the beginning concepts of fractions and is meant to coincide with Long Beach Unified School District's third grade fractions unit, "Mathematics Unit Plan for Grade 3: Unit 5 – Understanding Fractions as Numbers Unit Plan."

Instructional Goals. Upon completion of "Understanding Fractions in Grade 3," users will be able to:

- Name a fraction and its parts by determining the number of equal parts of the whole (i.e., circle, rectangle) and name the shaded/unshaded parts in fraction terminology (numerator, denominator) with 70% or more accuracy.
- Use their understanding of fractions to represent fractions using visual models (number line, 2-dimensional closed figures, bar model, group of things) and numerical notation with 70% or more accuracy.
- Determine fractional equivalence by using visual models (fraction circles, bar models, groups of things) and numerical notation. Problems will include fractions with like denominators and fractions with like numerators. The learner will use specific strategies and math symbols (<, >, and =) to compare, order, and model equivalent fractions with 70% or more accuracy.
- Solve a variety of real-life fraction word problems and performance tasks by choosing the most efficient strategy and using the UPS✓ (Understand, Plan, Solve, Check) problem solving procedure with 70% or more accuracy.

Evaluators. The following persons were chosen to evaluate the usability materials for "Understanding Fractions in Grade 3":

- Danny Sein – LBUSD Teacher, Grade 3 – SME, ID, teacher
- Bruce Blacklock – LBUSD Teacher, Grade 3 – SME, ID, teacher
- Eric Hatch – Long Beach City College Student – math major, private math tutor
- Three current 3rd grade Lincoln Elementary students – novice learners

Instructional Evaluations (IE) Instruments Used. Level 1 and Level 2 of the Don Kirkpatrick's four-level evaluation model will be used to evaluate the effectiveness of "Understanding Fractions for Grade 3." Level 1 analysis, called Reaction, refers to, "The participants' reaction to a training event. It is basically a measure of (internal) customer satisfaction" (Kirkpatrick, 2018). Data retrieved from this level will find out if the learner found the online course favorable, engaging, and relevant to their jobs. Level 2 analysis, Learning, measures the "degree to which participants acquire the intended knowledge, skills, attitude, confidence, and commitment based on their participation in the training." Data from this level will inform the types of content, activities, skills, and knowledge gleaned from this course. Table 4.2 summarizes the evaluation instruments used, instructional design stage, the test subjects/users, and the Kirkpatrick Level (KL)

Table 4.2

Summary of Instructional Evaluations Used

Instructional Evaluation Instruments	ID Stage	Test Subjects	KL
1. Reaction instrument for adults – "Survey of Course Design: Understanding Fractions in Grade 3" on Google Forms (Appendix F) to measure the likability of course.	Design	SMEs, IDs, Teachers, Google Certified Educators	1
2. Learning instrument for adults – "Survey of Content and Learning Activities: Understanding Fractions in Grade 3" on Google Forms (Appendix G) to measure the appropriateness and validity of the	Design	SMEs, IDs, Teachers, Google Certified Educators	2

content and activities as it relates to the learning objectives.			
3. Learning instruments for students – "Pre-test/Post-test: Understanding Fractions in Grade 3" on Google Forms to measure skills and knowledge before and after taking the course (Appendix H).	Development	Students	2
4. Reaction instrument for students – "MySurvey of Understanding Fractions in Grade 3" on Google Forms (Appendix I) to measure the likability of the course.	Development	Students	1

Data Presentation

User Evaluation Data. Each adult UE subject was tested in a separate test session, and elementary-aged student subjects were tested together in a small group during a designated afterschool tutorial period. All subjects were able to complete their UE testing sessions in under thirty minutes and went through the Home page, Weeks 1 through 4 pages, and Collaboration & Help page with relative ease. "Understanding Fractions in Grade 3" was 70% complete at the time of testing. Assessment, also called summative testing, was used to measure the overall usability of the website and not the subjects' knowledge of fractions. The UE assessment instruments used were the observation form (see Appendix C) and a post-session questionnaire (see Appendix D). On the observation form, qualitative data (thoughts & feelings, content & activities, and navigation) was entered by the ID while the subjects performed an oral "think aloud" to given tasks. These tasks include reading text and graphics (including Google Slides presentations); viewing video; navigating tabs, links, and buttons; performing practice games,

tasks, and assessments; and locating collaborative features such as discussion board and help form. Appeals for help and developmental errors were also recorded. When the UE test sessions were completed, the ID quantified the responses on a 4-point reaction scale, ranging from 1 (does not meet usability) to 4 (exceeds usability). The observation form data was averaged and has been summarized in Tables 4.3a and Tables 4.3b below:

Table 4.3a

UE Observation Form Data Summary: Task Analysis

	Observed Effectiveness: 1 = does not meet 2 = partially meets 3 = meets 4 = exceeds					
	Thoughts & Feelings		Content & Activities		Navigation	
Tasks	Adult	Student	Adult	Student	Adult	Student
1. Read text	3	3	3	3	3	4
2. Read graphics	3	3	4	3	4	4
3. View video	3	3	4	3	4	4
4. Navigate tabs, links, buttons	3	3	4	3	4	4
5. Perform games	4	4	4	4	4	4
6. Perform tasks	3	3	4	3	3	3
7. Perform assessments	4	3	4	4	4	4
8. Locating discussion board	4	4	3	4	4	4

9. Locating help form	4	4	3	4	4	4

Table 4.3b

UE Observation Form Data Summary: Help and Errors

	Adult	Student
Appeals for help	2	4
Developmental errors	2	5

In addition to the observation form, adult subjects were asked to complete the post-session questionnaire form administered on Google Forms. Quantitative response data on eighteen statements was analyzed, averaged, and presented in Table 4.4 below:

Table 4.4

UE Post-Session Questionnaire Data Summary

	Reaction Scale: 1 = strongly disagree 2 = disagree 3 = somewhat agree/disagree 4 = agree 5 = strongly agree
Statements	
1. I clearly understood the learning objectives.	5
2. I was able to complete tasks as requested.	4
3. The online course is appropriately challenging for beginning learners of fractions.	4

4.	The course website is easy to navigate.	5
5.	The course website was clear and organized.	4
6.	The naming and labeling of links were clear and took me where I needed to go.	4
7.	I found the content essential to learning success.	5
8.	The course website is engaging and will hold learner interest.	4
9.	The course website text was appropriate and appealing.	4
10.	The course website text was grammatically correct and made sense.	4
11.	The course website graphics were appropriate and appealing.	4
12.	Slide presentations were appropriate and will enhance learning.	5
13.	Videos were appropriate and will enhance learning.	5
14.	Practice problems through games were appropriate and will enhance learning.	5
15.	Practice tasks were appropriate and will enhance learning.	4
16.	Quizzes provided feedback to relearn content.	4
17.	The course website is a valuable supplemental resource for students.	5
18.	I would use and refer back to this course website to supplement direct instruction.	5

Note: Raw data for Table 4.4 can be found in Appendix J.

Instructional Evaluation Data. Similar to the UE, the instructional evaluation (IE) was completed in the same timeframe and with the same test subjects. The course website was 70%

completed at the time of the IE and major text, graphics, multimedia, and assessment features were not finalized. Four IE instruments were created; however, only the survey of content and learning activities (see Appendix G) and the MySurvey (see Appendix I) was used to evaluate the online course after the IE subjects completed the UE.

The survey of content and learning activities measured the appropriateness and validity of the content and activities as it relates to the learning objectives during the four-week course. Adult IE test subjects' reaction to the factors were recorded using Google Forms. Factors measured were content, accuracy, comprehensiveness of material, and alignment with the learning objectives on a three-point rating scale ranging from 1 no) to 3 (yes). Qualitative and quantitative data was averaged and presented in Table 4.5 below:

Table 4.5

IE Survey of Content and Learning Activities Data Summary

	Reaction Scale: 1 = no 2 = somewhat 3 = yes				
Questions	Home Page	Week 1	Week 2	Week 3	Week 4
1. Are course objectives clear and purposeful?	3	3	3	3	3
2. Are the content and activities clearly and logically organized?	3	3	3	3	3
3. Are students getting enough information?	3	3	3	3	3
4. Are the multimedia learning objects	3	3	3	3	3

appropriate and engaging?					
5. Rate the accuracy of the following:					
• slide presentation	3	3	--	--	--
• videos	3	3	3	3	3
• practice problems	3	3	3	3	3
• tasks	3	3	3	--	--
• quizzes	3	3	--	--	--
6. Rate the comprehensiveness of the following:					
• slide presentation	3	3	--	--	--
• videos	3	3	3	3	3
• practice problems	3	3	3	3	3
• tasks	3	3	3	--	--
• quizzes	3	3	--	--	--
7. Rate the alignment with objectives:					
• slide presentation	3	3	--	--	--
• videos	3	3	3	3	3
• practice problems	3	3	3	3	3
• tasks	3	3	3	--	--
• quizzes	3	3	--	--	--

Note. The double dash (--) signifies that test subjects did not view the feature because it was not available at the time of evaluation. Raw data for Table 4.5 can be found in Appendix K

The MySurvey was an IE reaction instrument used to measure students' likability of the course website. Student test subjects completed the MySurvey on Google Forms. Quantitative response data on nine statements was analyzed, averaged, and presented in Table 4.6 below:

Table 4.6

IE MySurvey Data Summary

	Reaction Scale: 1 = strongly disagree 2 = disagree 3 = somewhat agree/disagree 4 = agree 5 = strongly agree
Statements	Reaction
1. I clearly understood the learning objectives.	3
2. This course was challenging.	5
3. The course website is easy to navigate.	4
4. The course website helped me learn new things about fractions.	4
5. I understood fractions more after viewing the slide presentation and videos.	4
6. I understood fractions after doing the practice problems and tasks.	--
7. I understood fractions more after getting feedback from my quizzes.	--
8. I need this course website to understand fractions better.	4
9. I would use and refer back to this course website if I needed help in the future.	4

Note. The double dash (--) signifies that test subjects did not view the feature because it was not available at the time of evaluation. Raw data for Table 4.6 can be found in Appendix L.

Discussion

All six test subjects who participated in UE and IE provided the ID with specific feedback during the development phase of the ADDIE instructional design process. The data

gleaned will help the ID improve the functionality, effectiveness, and likeability of the course website "Understanding Fractions in Grade 3."

The test subjects all found the course website was useful resource towards helping students understand fractions on a deeper level. Among the main findings, all adult test subjects said they would use this course website to supplement their direct instruction in fractions. They noted that the web page design and web site navigation was consistent and predictable thereby making the experience easy to use. Another thing found was that adult test subjects felt that the use of visuals like picture graphics and videos will help students understand the different visual models used in third grade fractions. They all agreed that using an online course like this would be very beneficial to elementary-aged students.

There were some suggestions to improve the course. One subject remarked that although the site is comprehensive, there was too much text for an elementary student to read. Another suggestion indicated that the directions of weekly practice tasks could be briefly stated and that more student options for tasks should be offered, instead of one.

The ID who administered this both evaluations noted that this particular course delivery format was new to elementary students at the site. A teacher must facilitate each component of the course, particularly in the first few weeks, before students can use the course website independently.

Limitations

The following are study limitations and constraints to implementing the UE and IE plans:

- Technological – Adult evaluators must have desktops or laptops with access to Google for Education Tools (Google Sites, Docs, Forms, Sheets, and Slides). Chromebooks are readily available to LBUSD student evaluators. Evaluators must

have access to a high-speed Internet connection. The course website is available only to evaluators with a valid Gmail account and permissions from the LBUSD network.

- Human – All participants are employed by, currently attend, or have attended LBUSD schools. Adult evaluators have familiarity and mastery with elementary mathematical concepts and more than a decade of teaching each. Adult student evaluators have mathematical knowledge of fractions and about a year of tutoring experience with elementary school-age students. Elementary student evaluators are volunteers who have no prior experience with fractions or have had up to 1-2 years' experience but have not met proficiency on the CCSS fraction standards in third grade. Elementary students had to be guided through the online course with a teacher in a small-group, afterschool setting. Parent permissions must be granted.
- Financial – No monetary compensation was exchanged as participation was voluntary.
- Time – Evaluators spent time out of regular work and school hours to go through the course website and complete the evaluations. Evaluators were given one-week timeframe to complete the course. Student evaluators completed the online course as part of an afterschool tutorial session.

CHAPTER 5: Summary and Conclusion

The online course "Understanding Fractions in Grade 3" was created for third grade students who need additional language support, extra practice, and reinforcement in understanding the introductory concepts of fractions. Although there are numerous print resources and concrete materials for the teacher to use, having a centralized online site that comprises all the necessary resources to support students' 21st century learning was needed. This four-week, blended online course focused on teaching the learner new fractions concepts in a developmentally sequenced fashion so that students can construct an understanding through the learning activities that are laid out. Ultimately, students will know that fractions are an important part of our number system, integral in higher level math, and that it is used in everyday life.

Conclusion

"Understanding Fractions in Grade 3" is meant to be used in conjunction to traditional direct instruction in fractions. Each weeks' learning objectives explains the purpose of the learning and offers students a variety of multimedia learning objects, numerous engaging practice opportunities, assessments, formative feedback, and opportunities for asynchronous discussion with peers. An extensive literature review revealed that fractions are one of the most difficult math concepts to teach elementary school-aged students and the understanding of it is essential to further success in higher level math. Furthermore, fractions teaching is also hard for teachers who have not the organizational and instructional expertise in this subject, much less in a digital environment. This online course serves to bridge the gap between traditional teaching and learning and the 21st century skills that students are required to obtain for future success in academics and career.

The online course was created with the ADDIE model of instructional design in mind. The instructional designer conducted extensive analysis of the need for this resource and designed and developed it according to the constructivist principles of Vygotsky's Zone of Proximal Development and required standards set forth by the Common Core State Standards for Math, Framework for 21st Century Learning, National Council of Teachers of Math, and the Long Beach Unified School District. Each phase of the ADDIE process ensured that students' attainment of the learning goals and objectives were met. Going through the phases of ADDIE revealed that this course satisfied the needs of today's third graders because of its usability in design and navigation, engagement and interactivity, comprehensiveness and variety of the learning activities, and likability. The feedback from the various usability and instructional evaluations were valuable and enabled the instructional designer to improve the course even further.

Implications for Teaching

In order for LBUSD third grade teachers to begin to use "Understanding Fractions in Grade 3," several considerations need to be made. Firstly, there must be training on how to manipulate the online course, integrate it into their current pedagogy, and adjust instruction based on the formative feedback they receive from the students. If teachers want to add content or modify the course to suit the needs of their classroom, then they will need permissions from the ID and knowledge of Google Sites. In addition, teachers must take the time to teach students how to use and pace themselves with this supplementary learning resource. Secondly, teachers would have to take the time to monitor discussion boards and answer any question students submit on the help form on a consistent and timely basis. Even though it may seem like an extra step, the immediate feedback that teachers will get at each week of the course will inform their

next steps quickly and concisely and address any misconceptions might students have before they move on. In other words, it will home in on students' areas of need before their errors become a problem. Lastly, the way the online course is designed allows the student to move navigate freely and do the lessons, learning activities, and assessments in any order. Teachers must explicitly tell students which week and activity to focus on without moving too far ahead or lagging too far behind.

Implications for Further Research

This course website addresses only one math unit, "Understanding Fractions as Numbers" The instructional designer chose this unit (amongst the eight units that the LBUSD laid out for grade 3) as the first to create an online course for because fractions is considered the most difficult to teach and learn. In the future, it is recommended that websites that correspond to the other units (before fractions and after fractions) should be created, that way students have access to a blended learning environment year-round, not just for four weeks. The following list shows the math units in LBUSD scope and sequence for grade three:

1. Place Value with Addition and Subtraction
2. Exploring Multiplication and Division
3. Multiplication and Area of Plane Figures
4. Developing Multiplication and Division
5. Understand Fractions as Numbers
6. Measurement - Time, Metric Weight and Capacity
7. Geometry and Measurement
8. Collecting and Displaying Data

Designing and developing blended learning courses that align to the other math units is feasible because the flexibility and utility of the ADDIE model that was used can be applied to other blended learning courses. If that is the case, teachers and students can become familiar with the structure of the website and the expectations of each phase even though the content is different. Furthermore, this ADDIE model of instruction in math can also apply to other elementary grade level math courses and concepts.

REFERENCES

Ballard, J. K. (2010). *Web site usability: A case study of student perceptions of educational web sites* (Order No. 3408366). Available from ProQuest Dissertations & Theses Global. (597211428). Retrieved from https://conservancy.umn.edu/bitstream/handle/11299/91797/Ballard_umn_0130E_11150.pdf?sequence=1&isAllowed=y.

Bates, T. (2014). Is the addie model appropriate for teaching in a digital age? [Blog post]. Retrieved from https://www.tonybates.ca/2014/09/09/is-the-addie-model-appropriate-for-teaching-in-a-digital-age/.

Booth, J. L., & Newton, K. J. (2012). Fractions: Could they really be the gatekeeper's doorman? *Contemporary Educational Psychology, 37*(4), 247-253. https://doi.org/10.1016/j.cedpsych.2012.07.001.

Bottge, B. A., Cohen, A. S., & Choi, H. (2018). Comparisons of mathematics intervention effects in resource and inclusive classrooms. *Exceptional Children, 84*(2), 197-212. https://doi.org/10.1177/0014402917736854.

Bottge, B. A., Ma, X., Gassaway, L., Toland, M. D., Butler, M., & Cho, S. (2014). Effects of blended instructional models on math performance. *Exceptional Children, 80*(4), 423-437. doi:10.1177/0014402914527240.

Bruner, J. S. (1977). The process of education. Cambridge: Harvard University Press. In Hoch, S., Reinhold, F., Werner, B., Richter-Gebert, J., Reiss, K. (2018). Design and research potential of interactive textbooks: The case of fractions. *ZDM: The International Journal on Mathematics Education, 50*(5), 839-848. https://doi-org.nuls.idm.oclc.org/10.1007/s11858-018-0971-z.

Bruce, C. D., & Ross, J. (2009). Conditions for effective use of interactive on-line learning objects: The case of a fractions computer-based learning sequence. (Report). *Electronic Journal of Mathematics and Technology*, *3*(1), 13. Retrieved from https://php.radford.edu/~ejmt/deliveryBoy.php?paper=eJMT_v3n1p2.

Chappell, M. (2018). Instructional design using the addie model [Blog post]. Retrieved from https://elearningindustry.com/addie-model-instructional-design-using.

Common Core State Standards Initiative (CCSSI). (2018, December 1). Common core standards for mathematics (CCSSM). Washington, DC: National Governors Association Center for Best Practices and the Council of Chief State School Officers. Retrieved from http://www.corestandards.org/wp-content/uploads/Math_Standards.pdf.

Common Core Standards Writing Team. (2018). Progressions for the Common Core State Standards in Mathematics (August 10 draft). Tucson, AZ: Institute for Mathematics and Education, University of Arizona. Retrieved from http://mathematicalmusings.org/wpcontent/uploads/2018/08/ccss_progression_nf_35_2020_010.pdf.

Dixon, J. K. et al. (Eds.). (2105). *California go math! Grade 3*. Orlando, FL: Houghton Mifflin Harcourt Publishing Company.

Englard, L. (2015). News & views: common core brief: The fraction progression. *Teaching Children Mathematics*, *22*(4), 205-207. doi:10.5951/teacchilmath.22.4.0205.

Fletcher, G. (2016). The progression of fractions [Blog post]. Retrieved from https://gfletchy.com/2016/12/08/the-progression-of-fractions/.

Fractions by The Math Learning Center [Website]. (2019). Retrieved from https://apps.mathlearningcenter.org/fractions/.

Gresalfi, M., Rittle-Johnson, S., Loehr, B., & Nichols, A. (2018). Design matters: Explorations of content and design in fraction games. *Educational Technology, Research and Development, 66*(3), 579-596. https://doi-org.nuls.idm.oclc.org/10.1007/s11423-017-9557-7.

Harasim, L. (2017). *Learning Theory and Online Technologies*. New York, NY: Routledge.

Henningsen, M., & Stein, M. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 524-549. doi:10.2307/749690.

Hensberry, K. K. R., Moore, E. B., & Perkins, K. (2015a). Effective student learning of fractions with an interactive simulation. *Journal of Computers in Mathematics and Science Teaching, 34*(3), 273-298. Retrieved from https://www.learntechlib.org/primary/p/148049/.

Hensberry, K. K. R., Moore, E. B., & Perkins, K. (2015b). Using technology effectively to teach about fractions. *Australian Primary Mathematics Classroom, 20*(4), 19–25. Retrieved from https://nuls.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=111671345&site=ehost-live.

Hoch, S., Reinhold, F., Werner, B., Richter-Gebert, J., Reiss, K. (2018). Design and research potential of interactive textbooks: The case of fractions. *ZDM: The International Journal on Mathematics Education, 50*(5), 839-848. https://doi-org.nuls.idm.oclc.org/10.1007/s11858-018-0971-z.

Horsley, A. (2012). eLearning 101 part 4: Developmental process [Blog post]. Retrieved from https://elearningindustry.com/elearning-101-part-4-developmental-process.

Illustrative Mathematics [Website]. (2019). Retrieved from https://www.illustrativemathematics.org/.

Kirkpatrick Partners. (2018). The Kirkpatrick model [Blog post]. Retrieved at https://www.kirkpatrickpartners.com/OurPhilosophy/The-Kirkpatrick-Model.

Krowka, S. K., & Fuchs, L. S. (2017). Cognitive profiles associated with responsiveness to fraction intervention. *Learning Disabilities Research & Practice (Wiley-Blackwell)*, *32*(4), 216–230. https://doi.org/10.1111/ldrp.12146.

Krug, S. (2006). *Don't make me think: A common sense approach to web usability* (Second ed.). Berkeley, CA: New Riders.

Long Beach Unified School District. (2018). Mathematics unit plan for grade 3: unit 5 – understanding fractions as numbers unit plan.

Long Beach Unified School District. (2018). Mathematics scope and sequence for grade 3.

Ludden, D. (2017). Why is doing arithmetic with factions so difficult? [Blog post]. Retrieved from https://www.psychologytoday.com/us/blog/talking-apes/201709/why-is-doing-arithmetic-fractions-so-difficult.

McGriff, S. (2000). *Instructional system design (ISD): Using the addie model*. Retrieved from https://www.lib.purdue.edu/sites/default/files/directory/butler38/ADDIE.pdf.

Mendiburo, M. & Hasselbring, T. (2014). Technology's impact on fraction learning: An experimental comparison of virtual and physical manipulatives. *Journal of Computers in Mathematics and Science Teaching*, *33*(2), 209. Retrieved from https://www.learntechlib.org/p/48044.

Misquitta, R. (2011). A review of the literature: Fraction instruction for struggling learners in mathematics. *Learning Disabilities Research & Practice, 26*(2), 109–119. https://doi.org/10.1111/j.1540-5826.2011.00330.x.

Molenda, M. (2015). In search of the elusive ADDIE model. *Performance Improvement*, 54(2), 40-42. Retrieved from doi:10.1002/pfi.21461.

Musti-Rao, S. (2017). Introduction to special issue: Integrating technology within classroom practices. *Intervention in School and Clinic, 52*(3), 131-132. https://doi.org/10.1177/1053451216644824.

Myers, J. M. (2015). *Usability in online course design: Comparative perspectives on ease-of-use, satisfaction, motivation, and teacher presence* (Order No. 3714650). Available from ProQuest Dissertations & Theses Global. (1700219343). Retrieved from https://nuls.idm.oclc.org/login?url=https://search-proquest-com.nuls.idm.oclc.org/docview/1700219343?accountid=25320.

Nielsen, J. (1993). *Usability engineering.* Cambridge, MA: Academic Press.

Partnership for 21st Century Learning. (2016). Framework for 21st century learning [Blog post]. Retrieved from http://www.p21.org/our-work/p21-framework.

Piskurich, G.M. (2006). *Rapid instructional design: Learning ID fast and right*. San Francisco, CA: Pfeiffer.

Reimer, K., & Moyer, P. S. (2005). Third-graders learn about fractions using virtual manipulatives: A classroom study. *The Journal of Computers in Mathematics and Science Teaching, 24*(1), 5-25. Retrieved from https://nuls.idm.oclc.org/login?url=https://search-proquest-com.nuls.idm.oclc.org/docview/220623981?accountid=25320.

Rodgers, D. (2016). The importance of online discussions and how to make them awesome [Blog post]. Retrieved from https://www.schoology.com/blog/importance-online-discussions-and-how-make-them-awesome.

Ross, J., Sibbald, T., & Bruce, C. (2009). Characteristics of students assigned to technology-based instruction. *Journal of Computer Assisted Learning, 25*(6), 562-573. https://doi-org.nuls.idm.oclc.org/10.1111/j.1365-2729.2009.00328.x.

Rubin, J. and Chisnell, D. (2008). *Handbook of usability testing* (Second ed.). Indianapolis, IN: Wiley. Retrieved from http://ccftp.scu.edu.cn:8090/Download/efa2417b-08ba-438a-b814-92db3dde0eb6.pdf.

SBAC Interim Assessments [Website]. (2019). California Department of Education. Education Testing Service. Retrieved from http://www.caaspp.org/.

Smarter Assessments - Smarter Balanced Assessment Consortium. (2019). Retrieved from http://www.smarterbalanced.org/assessments/.

ST Math [Website]. (2019). Irvine, CA: MIND Research Institute. Retrieved from https://www.stmath.com/.

Sutton, N. (2015). What the research says about 1:1 [Blog post]. Retrieved from https://www.edutopia.org/discussion/what-research-says-about-11.

ThinkCentral [Website]. (2019). Orlando, FL: Houghton Mifflin Harcourt Publishing Company. Retrieved from https://www-k6.thinkcentral.com/ePC/start.do.

University of Arizona - Institute for Mathematics and Education. (2007). Progressions Documents for the Common Core Math Standards [Blog post]. The Arizona Board of Regents. Retrieved from http://ime.math.arizona.edu/progressions/.

Usability.gov. (2018, December 22). Usability evaluation basics [Blog post]. Retrieved from https://www.usability.gov/what-and-why/usability-evaluation.html.

Verrett, S. J. (2015). *Blended learning in context: An exploration of the effectuality of math blended learning programs on minority students' standardized test scores* (Order No. 3713705). Available from ProQuest Central; ProQuest Dissertations & Theses Global. (1698254656). Retrieved from https://nuls.idm.oclc.org/login?url=https://search-proquest-com.nuls.idm.oclc.org/docview/1698254656?accountid=25320.

Vygotsky L.S., et al. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Williams, R. & Tollet, J. (2006). *The non-designer's web book*. Berkeley, CA: Peachpit Press.

Yakubova, G., Hughes, E., & Hornberger, E. (2015). Video-based intervention in teaching fraction problem-solving to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*(9), 2865-2875. doi:10.1007/s10803-015-2449-y.

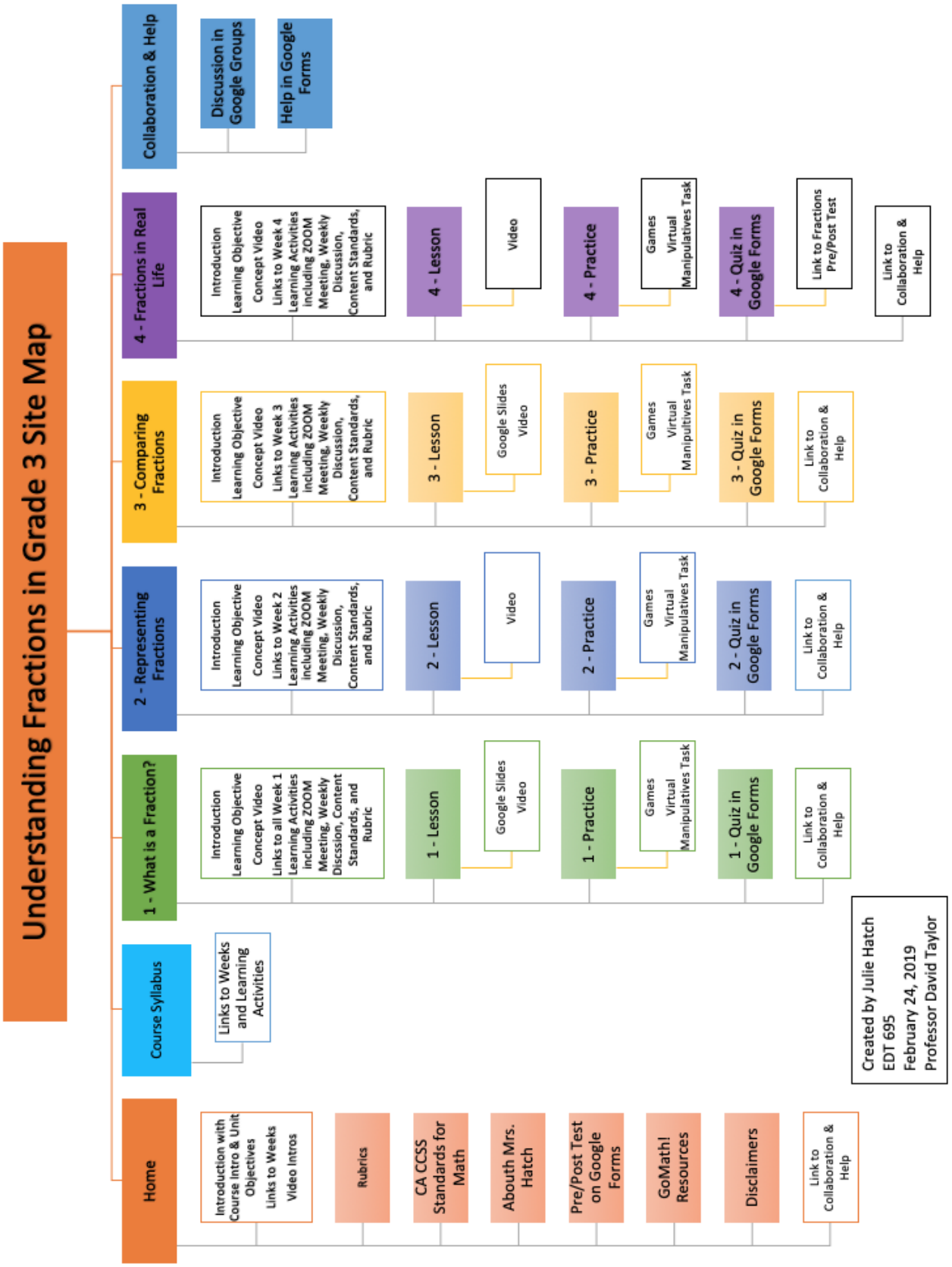
Zahner, W., Velazquez, G., Moschkovich, J., Vahey, P., & Lara-Meloy, T. (2012). Mathematics teaching practices with technology that support conceptual understanding for Latino/a students. *Journal of Mathematical Behavior, 31*(4), 431-446. https://doi.org/10.1016/j.jmathb.2012.06.002.

Zavadsky, H. (2016). Bringing effective instructional practice to scale in American schools: Lessons from the Long Beach Unified School District. *Journal of Educational Change, 17*(4), 505–527. https://doi.org/10.1007/s10833-016-9287-3.

APPENDICES

Appendix A

Understanding Fractions in Grade 3 Site Map


Understanding Fractions in Grade 3 Site Map
Home
Introduction with Course Intro & Unit Objectives
Links to Weeks Video Intros
Rubrics
CA CCSS Standards for Math
Abouth Mrs. Hatch
Pre/Post Test on Google Forms
GoMath! Resources
Disclaimers
Link to Collaboration & Help
Course Syllabus
Links to Weeks and Learning Activities
1 - What is a Fraction?
Introduction
Learning Objective
Concept Video
Links to all Week 1 Learning Activities including ZOOM Meeting, Weekly Discssion, Content Standards, and Rubric
1 - Lesson
Google Slides Video
1 - Practice
Games
Virtual Manipulatives Task
1 - Quiz in Google Forms
Link to Collaboration & Help
2 - Representing Fractions
Introduction
Learning Objective
Concept Video
Links to Week 2 Learning Activities including ZOOM Meeting, Weekly Discussion, Content Standards, and Rubric
2 - Lesson
Video
2 - Practice
Games
Virtual Manipulatives Task
2 - Quiz in Google Forms
Link to Collaboration & Help
3 - Comparing Fractions
Introduction
Learning Objective
Concept Video
Links to Week 3 Learning Activities including ZOOM Meeting, Weekly Discussion, Content Standards, and Rubric
3 - Lesson
Google Slides Video
3 - Practice
Games
Virtual Manipulatives Task
3 - Quiz in Google Forms
Link to Collaboration & Help
4 - Fractions in Real Life
Introduction
Learning Objective
Concept Video
Links to Week 4 Learning Activities including ZOOM Meeting, Weekly Discussion, Content Standards, and Rubric
4 - Lesson
Video
4 - Practice
Games
Virtual Manipulatives Task
4 - Quiz in Google Forms
Link to Fractions Pre/Post Test
Link to Collaboration & Help
Collaboration & Help
Discussion in Google Groups
Help in Google Forms
Created by Julie Hatch
EDT 695
February 24, 2019
Professor David Taylor

Appendix B.1

Usability Evaluation (I.E.) Instrument

Test Session Script

Appendix B.1

U.E. Instrument - Test Session Script

"Hi, ____. My name is ____, and I'm going to be walking you through this session today. We're here to test a website that will be used as a supplemental resource by students taking fractions for the first time. This website is meant for students to reinforce and review fraction concepts, give them practice with certain problems, and feedback."

"I would like to know what it would be like for an actual person to use it. The session should take about 30 minutes and no more than one hour."

"The first thing I want to make clear right away is that I'm testing the website, and not your knowledge of fractions. You can't do anything wrong here. In fact, it's ok for me to see if you are having trouble with something so that I can fix it. Please be honest. I won't be hurt if there is something you think isn't working or if you're confused. I just want to improve the website."

"As you use the site, I'm going to ask you as much as possible to try to think out loud to say what you're looking at, what you're trying to do, and what you're thinking. This will be a big help to me."

"If you have any questions, please ask. I may not be able to answer them, but I would like to see and hear how you attempt to answer your own questions. I will try to answer any remaining questions at end of our session."

"With your permission, I would like to record the computer screen as you navigate the website, as well as voice record your 'think aloud' and responses to my questions using Google Extension called Screencastify. The recording will help me improve the course and provide me with an additional method for taking notes, besides my handwritten notes."

"If you agree to all the above, can you please sign the permission form? It gives me permission to record this session and will only be seen by me and others that are working on the website." [Give permission form]

"Thanks. Now I'm going to ask you to try doing some specific tasks. I'm going to read it out loud."

"Do you have any questions before we begin?" [Answer any questions].

"Ok, let's start testing."

Appendix B.2

U.E. Instrument

Test Directions Script

Appendix B.2

U.E. Instrument - Test Directions Script

"____, you are going to follow a series of tasks that will give me an idea your thoughts and impressions of the general look and feel of the website, the content and learning activities, and the navigation."

"Again, please be honest and try figuring out the steps to the tasks on your own. Please 'think aloud' what is on your mind so I can record any responses or questions you might have. Your feedback is very valuable to me and will give me the information to make further improvements and changes to the website."

"On tests and quizzes, it's ok to make mistakes. In fact, I'd like you to purposefully make a mistake on any problem to see what happens."

"Please enter the URL address to access the course: http://xxxxxxx."

"On the paper next to the computer, you will see a set of directions. Please begin with Step 1, which will give you your first set of tasks. If at any time you need a break, please let me know."

Test Directions

Step 1 – Home Page

1. Read the text (introduction, headings, subheadings, course/lesson objectives, CCSS standards).
2. Read the graphics.
3. Click on the videos.
4. Exit out of the videos and navigate back to Home Page.
5. Find the at the course tabs (Week 1, Week 2, etc.), click on each one, and navigate back to Home Page.
6. Locate the Collaboration & Help tab.

Step 2 – Week 1 – Understanding Fractions

1. Read the text.
2. Read the graphics.
3. View the slideshow.
4. View the video.
5. Do the practice problems.
6. Do the quiz.
7. Locate the Collaboration & Help tab.

Step 3 – Week 2 – Representing Fractions

1. Read the text.

2. Read the graphics.
3. View the slideshow.
4. View the video.
5. Do the practice problems.
6. Do the quiz.
7. Locate the Collaboration & Help tab.

Step 4 – Week 3 – Comparing Fractions

1. Read the text.
2. Read the graphics.
3. View the slideshow.
4. View the video.
5. Do the practice problems.
6. Do the quiz.
7. Locate the Collaboration & Help tab.

Step 5 – Week 4 – Fractions in Everyday Life

1. Read the text.
2. Read the graphics.
3. View the slideshow.
4. View the video.
5. Do the practice problems.
6. Do the quiz.
7. Locate the Collaboration & Help tab.

Step 6 – Collaboration & Help

1. Read the text.
2. Read the graphics.
3. Navigate to Discussion Forum in Google Groups where students can collaborate with each other.
4. Post a discussion item on the Discussion Forum.
5. Navigate to the Help Form.
6. Send a question using the Help Form in Google Forms.

"Thank you for your participation and input on this portion of the Usability Test. Now, please fill out the post-session questionnaire on Google Forms. I appreciate your help!"

Appendix C

U.E. Instrument

Observation & Record of User Comments Form

Appendix C

U.E. Instrument - Observation & Record of User Comments Form

User:		Date:	
Tasks	**Thoughts & Feelings**	**Content and Activities**	**Navigation**
Home Page Start Time End Time 1. Read the text (introduction, headings, subheadings, course/lesson objectives, CCSS standards). 2. Read the graphics. 3. Click on the videos. 4. Exit out of the videos and navigate back to Home Page. 5. Find the at the course tabs (Week 1, Week 2, etc.), click on each one, and navigate back to Home Page. 6. Locate the Collaboration & Help tab.			
How many times did tester ask for help:			
Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			
Tasks	**Thoughts & Feelings**	**Content and Activities**	**Navigation**
Week 1 Start Time End Time 1. Read the text. 2. Read the graphics.			

3. View the slideshow. 4. View the video. 5. Do the practice problems. 6. Do the quiz. 7. Locate the Collaboration & Help tab.			
How many times did tester ask for help:			
Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			
Tasks	**Thoughts & Feelings**	**Content and Activities**	**Navigation**
Week 2 Start Time End Time 1. Read the text. 2. Read the graphics. 3. View the slideshow. 4. View the video. 5. Do the practice problems. 6. Do the quiz. 7. Locate the Collaboration & Help tab.			
How many times did tester ask for help:			
Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			

Tasks	Thoughts & Feelings	Content and Activities	Navigation
Week 3 Start Time End Time 1. Read the text. 2. Read the graphics. 3. View the slideshow. 4. View the video. 5. Do the practice problems. 6. Do the quiz. 7. Locate the Collaboration & Help tab.			
How many times did tester ask for help:			
Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			
Tasks	**Thoughts & Feelings**	**Content and Activities**	**Navigation**
Week 4 Start Time End Time 1. Read the text. 2. Read the graphics. 3. View the slideshow. 4. View the video. 5. Do the practice problems. 6. Do the quiz. 7. Locate the Collaboration & Help tab.			
How many times did tester ask for help:			

Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			
Tasks	**Thoughts & Feelings**	**Content and Activities**	**Navigation**
Collaboration & Help Start Time End Time 1. Read the text. 2. Read the graphics. 3. Navigate to Discussion Forum in Google Groups where students can collaborate with each other. 4. Post a discussion item on the Discussion Forum. 5. Navigate to the Help Form. 6. Send a question using the Help Form in Google Forms.			
How many times did tester ask for help:			
Areas tester needed help with:			
Development errors found:			
Number and description or errors made by tester:			

Appendix D

U.E. Instrument

Post-Session Questionnaire Data Summary

Appendix D: Post-Session Questionnaire for Understanding Fractions in Grade 3

* Required

1. **Name**

2. **Job Title**

Assessment Test Post-Session Questionnaire

After reviewing the course website, please rate the following items on the scale provided. Pick the response that best indicates your opinion.

3. **I clearly understood the learning objectives.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. **I was able to complete tasks as requested**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. **The online course is appropriately challenging for beginning learners of fractions.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. **The course website is easy to navigate.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. **The course website was clear and organized.** *
Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

8. **The naming and labeling of links were clear and took me where I needed to go.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **I found the content essential to learning success.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

10. **The course website is engaging and will hold learner interest.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **The course website text was appropriate and appealing.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **The course website text was grammatically correct and made sense.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **The course website graphics was appropriate and appealing.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

14. **Slide presentations were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

15. **Videos were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Stronly Agree

16. **Practice problems were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

17. **Quizzes provide feedback to relearn content.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

18. **This course website is a valuable supplemental resource for students.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

19. **I would use and refer back to this course website to supplement direct instructio**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

20. **Any other comments or suggestions to improve this course website:**

_____

_____

_____

_____

Appendix E

U.E. Instrument

Consent to Record

Appendix E

U.E. Instrument - Consent to Record

Read the following statement.

"I agree to participate in the Usability Evaluation study conducted by Julie C. Hatch to review the website called "Understanding Fractions for Grade 3."

"I understand the participation in this study is voluntary and I agree to immediately raise any concerns or areas of discomfort during the session with the study administrator. I understand the video and audio recordings will only be viewed and listened to by Julie C. Hatch."

Please sign below to indicate that you have read and understand the test directions and the information on this form. Any questions that you might have about this session have been answered.

Print your name: Date:

_____ _____

Signature:

_____

Thank you!

I appreciate your participation.

Appendix F

Instructional Evaluation (I.E.) Instrument

Survey of Course Design

Appendix F: Survey of Course Design for Understanding Fractions for Grade 3

1. **Name**

2. **Job Title (check all that apply)**
   Check all that apply.

- [ ] Teacher
- [ ] Academic Coach / Curriculum Designer
- [ ] Administrator
- [ ] Instructional Designer
- [ ] Subject Matter Expert (SME)
- [ ] User
- [ ] Other:

Reactionary Survey

After reviewing the course website, please rate the following items on the scale provided. Pick the response that best indicates your opinion.

3. **I clearly understood the learning objectives.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. **The online course is appropriately challenging for beginning learners of fractions.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. **The course website is easy to navigate.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. **I found the content essential to learning success.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. **The course website is engaging and will hold learner interest.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. **Slide presentations were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **Videos were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Stronly Agree

10. **Practice problems were appropriate and will enhance learning.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **Quizzes provide feedback to relearn content.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **This course website is a valuable supplemental resource for students.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **I would use and refer back to this course website to supplement direct instruction.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

14. **Any other comments or suggestions to improve this course website:**

Appendix G

I.E. Instrument

Survey of Content & Learning Activities

Appendix G: Survey of Content and Learning Activities for Understanding Fraction in Grade 3

Learning Survey: Subject Matter Review

After reviewing the course website, please rate the following items on the scale provided. Pick the response that best indicates your opinion.

1. **Name**

_____

2. **Job Title (check all that apply)**
Check all that apply.

- [ ] Teacher
- [ ] Academic Coach / Curriculum Designer
- [ ] Administrator
- [ ] Instructional Designer
- [ ] Subject Matter Expert (SME)
- [ ] User
- [ ] Other: _____

Introduction Page

Please answer the following questions and provide an explanation for each.

3. **Are the course objectives presented in the Introduction clear and purposeful?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

4. **Are students given enough information about what the course will cover?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

5. **Are the video examples appropriate and engaging for the course?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

6. **Please explain feedback and add additional comments or suggestions for the Introduction:**

_____

_____

_____

_____

_____

Phase 1: Understanding Fractions

Please answer the following questions and provide an explanation for each.

7. **Are the course objectives presented in Phase 1 clear and purposeful?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

8. **Are content and activities clearly and logically organized?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

9. **Rate the ACCURACY of the following:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

10. **Please rate the COMPREHENSIVENESS of the following in Phase 1:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

11. **Content and Activity ALIGNS WITH OBJECTIVES in Phase 1:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

12. **Please explain feedback and add additional comments or suggestions for Phase 1:**

_____

_____

_____

_____

_____

Phase 2: Representing Fractions

Please answer the following questions and provide an explanation for each.

13. **Are the course objectives presented in Phase 2 clear and purposeful?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

14. **Are content and activities clearly and logically organized?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

15. **Rate the ACCURACY of the following:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

16. **Please rate the COMPREHENSIVENESS of the following in Phase 2:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

17. **Content and Activity ALIGNS WITH OBJECTIVES in Phase 2:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

18. **Please explain feedback and add additional comments or suggestions for Phase 2:**

_____

_____

_____

_____

_____

Phase 3: Comparing Fractions

Please answer the following questions and provide an explanation for each.

19. **Are the course objectives presented in Phase 3 clear and purposeful?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

20. **Are content and activities clearly and logically organized?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

21. **Rate the ACCURACY of the following:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

22. **Please rate the COMPREHENSIVENESS of the following in Phase 3:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

23. **Content and Activity ALIGNS WITH OBJECTIVES in Phase 3:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

24. **Please explain feedback and add additional comments or suggestions for the Phase 3:**

_____

_____

_____

_____

_____

Phase 4: Fractions in Everyday Life

Please answer the following questions and provide an explanation for each.

25. **Are the course objectives presented in Phase 4 clear and purposeful?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

26. **Are content and activities clearly and logically organized?**
Mark only one oval.

- ◯ No
- ◯ Somewhat
- ◯ Yes
- ◯ Other: _____

27. **Rate the ACCURACY of the following:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

28. **Please rate the COMPREHENSIVENESS of the following in Phase 4:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

29. **Content and Activity ALIGNS WITH OBJECTIVES in Phase 4:**
Check all that apply.

	No	Somewhat	Yes
Slideshow	☐	☐	☐
Videos	☐	☐	☐
Practice Problems	☐	☐	☐
Quiz	☐	☐	☐

30. **Please explain feedback and add additional comments or suggestions for Phase 4:**

Appendix H

I.E. Instrument

Pre-Test/Post-Test for Understanding Fractions in Grade 3

Appendix H: Understanding Fractions for Grade 3 Pre- and Post-Test

1. **Name**

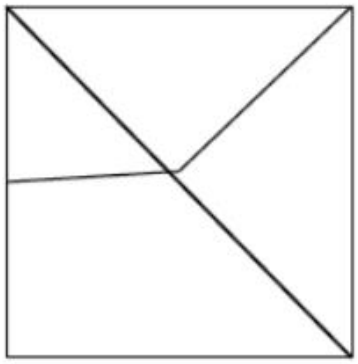
2. **This is a**
   Mark only one oval.
   - ◯ Pre-Test
   - ◯ Post-Test

Each question is worth 1 point.

3. **Patty folded this piece of paper into equal parts. Which word makes this sentence true? "The paper is folded into _____."**

   Mark only one oval.
   - ◯ fourths
   - ◯ halves
   - ◯ eighths
   - ◯ sixths

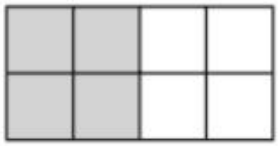
4. **Is this shape below divided into equal parts?**



Mark only one oval.

- ◯ Yes
- ◯ No

5. **Tony makes a tile design with square tiles. He wants 4/8 of the tiles to be red. Which fraction is equivalent to 4/8?**



Mark only one oval.

- ◯ A - 1/4
- ◯ B - 1/3
- ◯ C - 1/2
- ◯ D - 3/4

6. **Ming uses 3/4 cup of peanuts and 1/4 cup of raisins to make a snack. Which statement correctly compares the fractions?**

Mark only one oval.

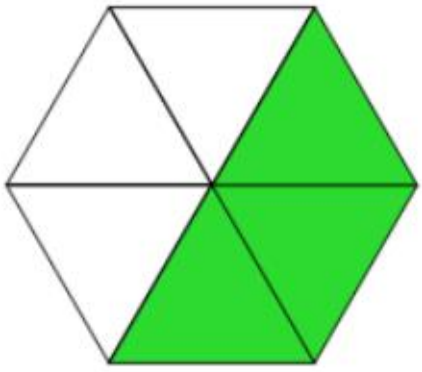
- ◯ A - 3/4 = 1/4
- ◯ B - 1/4 > 3/4
- ◯ C - 3/4 < 1/4
- ◯ D - 3/4 > 1/4

7. **Four friends share 6 cookies equally. How much does each friend get?**

Mark only one oval.

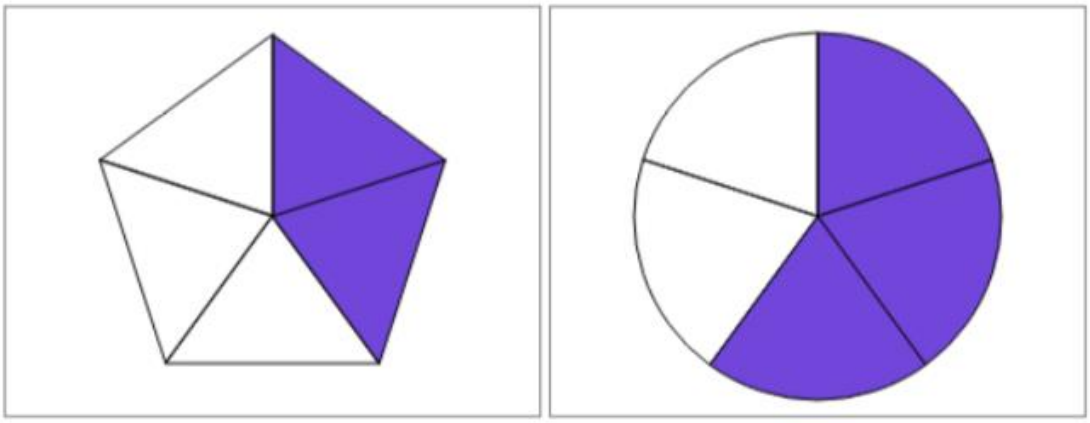
- A - 1 whole and 1 sixths
- B - 1 whole and 1 fourth
- C - 1 whole and 1 third
- D - 1 whole and 1 half

8. **Write the fraction for the following shape. Use the dash sign (/) to separate your numerator and denominator.**

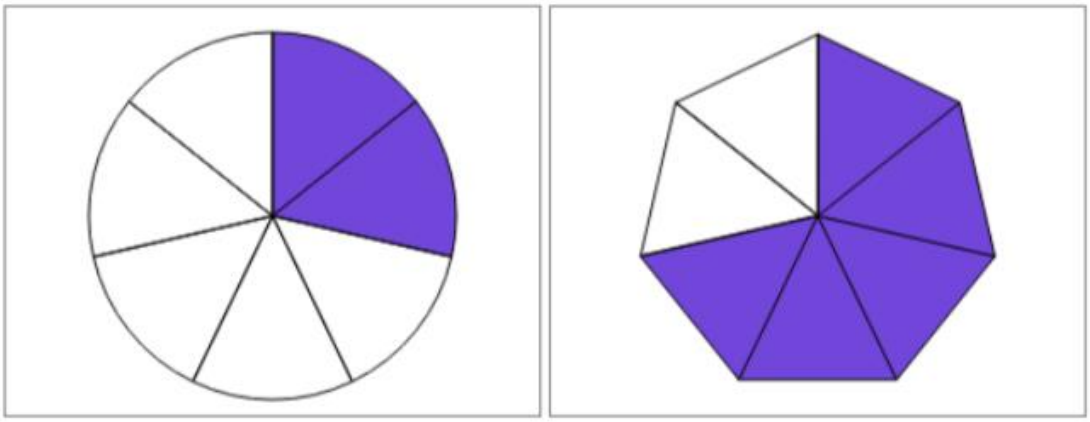


9. **What shape is 3/5 shaded?**

Mark only one oval.

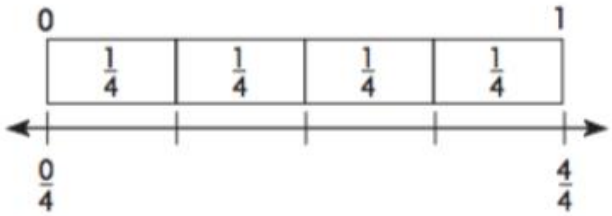


A B



C D

10. **Lucy road her bike around the block 4 times for a total of 1 mile yesterday. Today she wants to ride her bike 3/4 of a mile. How many times will she need to ride her bike around the block?**



Mark only one oval.

- A - 3 times
- B - 2 times
- C - 4 times
- D - 5 times

11. **Thomas and Marty used fabric to make costumes for a play. Thomas used 3/4 yard of fabric and Marty used 5/6 yard. Who used more fabric?**

Mark only one oval.

- ◯ Thomas
- ◯ Marty

12. **How do you know?**

Mark only one oval.

- ◯ A - 3/4 > 5/6
- ◯ B - 3/4 = 5/6
- ◯ C - 3/4 < 5/6
- ◯ D - none of the above

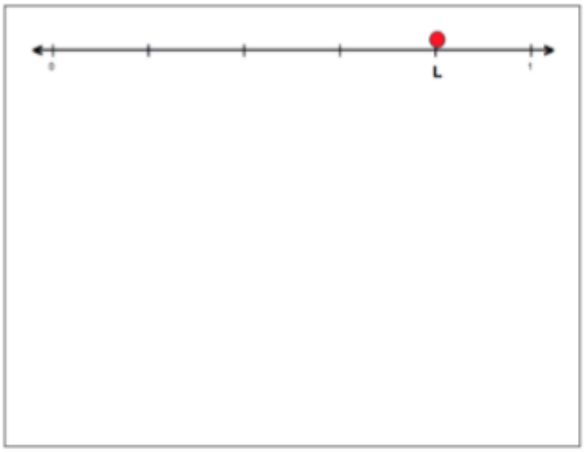
13. **What options identifies the fractions represented by J and K on the number line?**

Mark only one oval.

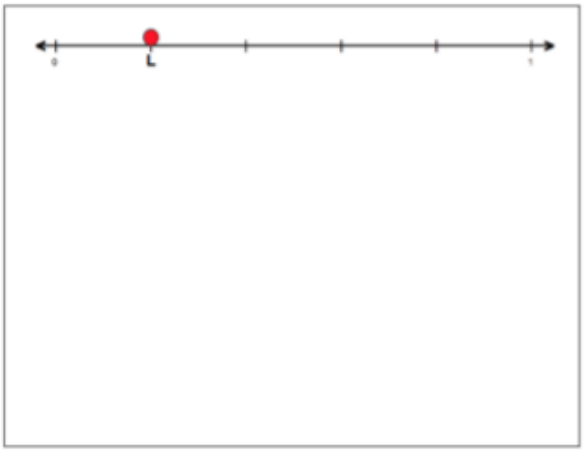
- ◯ A - 2/2 and 2/3
- ◯ B - 2/4 and 3/4
- ◯ C - 1/3 and 3/3
- ◯ D - 1/3 and 2/3

14. **Which number line shows Point L located at 3/5?**

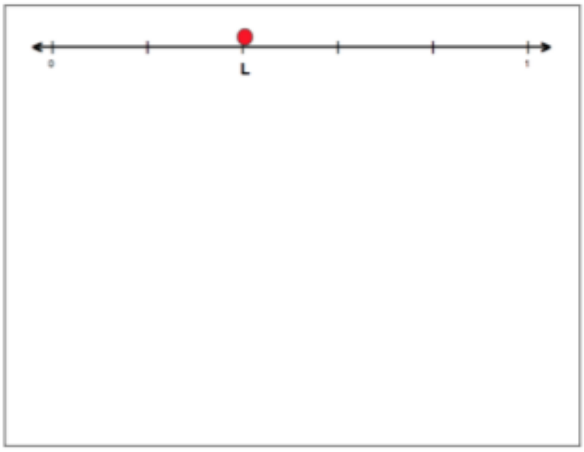
Mark only one oval.



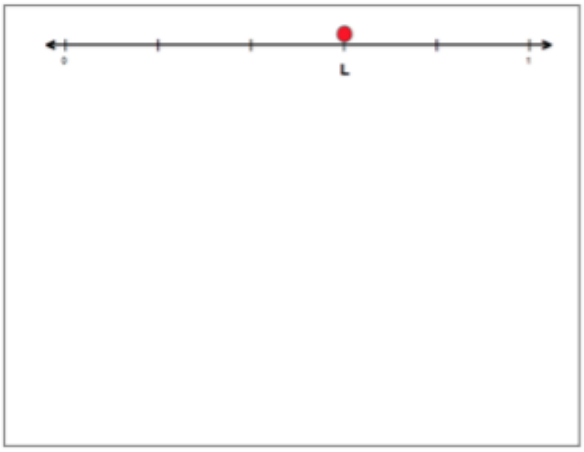
A



B

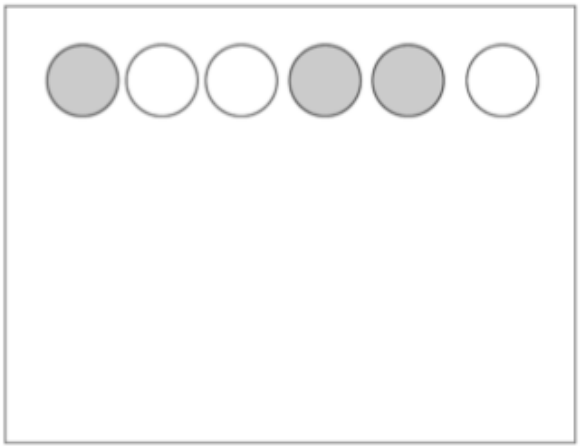


C

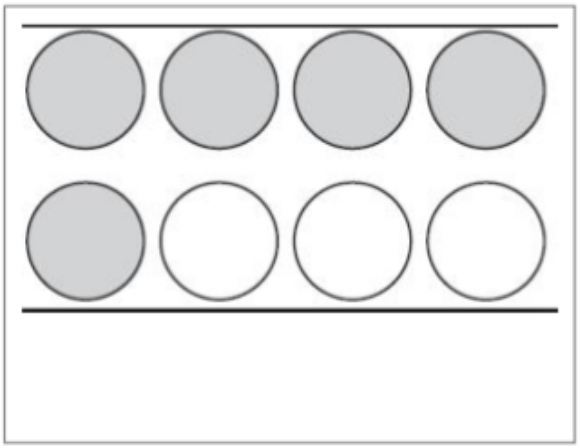


D

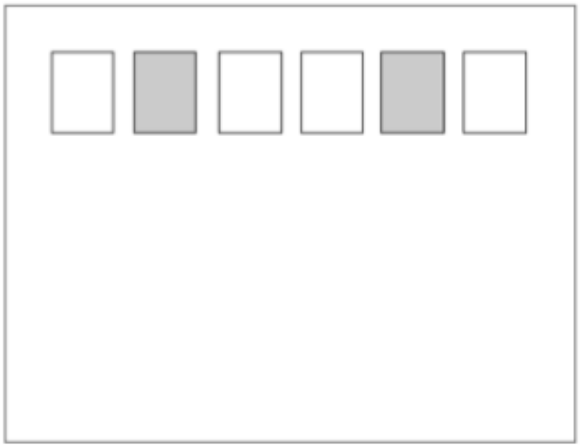
15. **What representation shows 2/6 shaded?**
Mark only one oval.



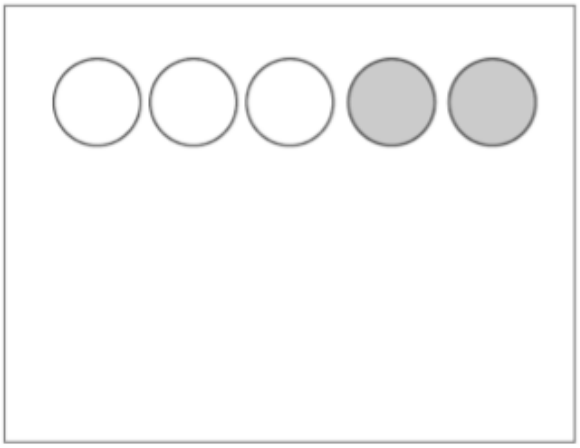
A



B



C



D

Appendix I

I.E. Instrument

MySurvey of Understanding Fractions in Grade 3

Appendix I: MySurvey of Understanding Fractions in Grade 3

Survey for Students

1. **Name**

2. **Student Grade (check all that apply)**
   Check all that apply.
   - [ ] 3rd
   - [ ] 4th
   - [ ] 5th
   - [ ] Middle School
   - [ ] High School
   - [ ] College
   - [ ] Other: _____

Reactionary Survey

After reviewing the course website, please rate the following items on the scale provided. Pick the response that best indicates your opinion.

3. **I clearly understood the learning objectives.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. **This course was challenging.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. **The course website is easy to navigate.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. **The course website helped me learn new things about fractions.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. **The course website is engaging and interesting.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. **I understood fractions more after viewing the slide presentations.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **I understood fractions more after viewing the videos.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Stronly Agree

10. **I understood fractions more after doing the practice problems.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **I understood fractions more after getting feedback from my quizzes.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **I need this course website to understand fractions better.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **I would use and refer back to this course website if I needed help in the future.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

14. **Any other comments or suggestions to improve this course website:**

_____

_____

_____

_____

_____

Appendix J

U.E. Post-Session Questionnaire Data Summary

(Table 4.4, Appendix D)

Raw Data

Appendix J

U.E. Post-Session Questionnaire Data Summary – Raw Data

User 1 = B.B. User 2 = D.S. User 3 = E.H,	Reaction Scale: 1 = strongly disagree 2 = disagree 3 = somewhat agree/disagree 4 = agree 5 = strongly agree

Statements	User 1	User 2	User 3	Avg.
1. I clearly understood the learning objectives.	5	5	5	5
2. I was able to complete tasks as requested.	5	4	4	4
3. The online course is appropriately challenging for beginning learners of fractions.	4	4	5	4
4. The course website is easy to navigate.	5	5	5	5
5. The course website was clear and organized.	4	5	5	4
6. The naming and labeling of links were clear and took me where I needed to go.	4	5	5	4
7. I found the content essential to learning success.	5	5	5	5
8. The course website is engaging and will hold learner interest.	4	5	4	4
9. The course website text was appropriate and appealing.	4	4	5	4
10. The course website text was grammatically correct and made sense.	4	4	5	4
11. The course website graphics were appropriate and appealing.	4	4	5	4

12. Slide presentations were appropriate and will enhance learning.	5	4	5	5
13. Videos were appropriate and will enhance learning.	5	4	5	5
14. Practice problems through games were appropriate and will enhance learning.	5	4	5	5
15. Practice tasks were appropriate and will enhance learning.	4	5	4	4
16. Quizzes provided feedback to relearn content.	4	5	4	4
17. The course website is a valuable supplemental resource for students.	5	5	5	5
18. I would use and refer back to this course website to supplement direct instruction.	5	5	5	5

Appendix K

I.E. Survey of Content & Learning Activities Data Summary

(Table 4.5, Appendix G)

Raw Data

Appendix K

I.E. Survey of Content & Learning Activities Data Summary – Raw Data

Reaction Scale:
1 = no
2 = somewhat
3 = yes

Questions	Home Page				Week 1				Week 2				Week 3				Week 4			
	User 1	User 2	User 3	Avg.	User 1	User 2	User 3	Avg.	User 1	User 2	User 3	Avg.	User 1	User 2	User 3	Avg.	User 1	User 2	User 3	Avg.
1. Are course objectives clear and purposeful?	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2. Are the content and activities clearly and logically organized?	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
3. Are students getting enough information?	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4. Are the multimedia learning objects appropriate and engaging?	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5. Rate the accuracy of the following:																				
• slide presentation	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--
• videos	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• practice problems	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• tasks	3	3	3	3	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--
• quizzes	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--

6. Rate the comprehensiveness of the following:																			
• slide presentation	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--
• videos	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• practice problems	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• tasks	3	3	3	3	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--
• quizzes	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--
7. Rate the alignment with objectives:																			
• slide presentation	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--
• videos	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• practice problems	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
• tasks	3	3	3	3	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--
• quizzes	3	3	3	3	3	3	3	3	--	--	--	--	--	--	--	--	--	--	--	--

Note. The double dash (--) signifies that test subjects did not view the feature because it was not available at the time of evaluation.

Appendix L

I.E. MySurvey Data Summary

(Table 4.6, Appendix I)

Raw Data

Appendix L

I.E. MySurvey Data Summary – Raw Data

	Reaction Scale: 1 = strongly disagree 2 = disagree 3 = somewhat agree/disagree 4 = agree 5 = strongly agree

Statements	Reaction			
	Student 1	Student 2	Student 3	Avg.
1. I clearly understood the learning objectives.	3	3	3	3
2. This course was challenging.	5	5	5	5
3. The course website is easy to navigate.	5	4	5	4
4. The course website helped me learn new things about fractions.	5	4	4	4
5. I understood fractions more after viewing the slide presentation and videos.	4	4	4	4
6. I understood fractions after doing the practice problems and tasks.	--	--	--	--
7. I understood fractions more after getting feedback from my quizzes.	--	--	--	--
8. I need this course website to understand fractions better.	4	4	4	4
9. I would use and refer back to this course website if I needed help in the future.	5	4	4	4

Note. The double dash (--) signifies that test subjects did not view the feature because it was not available at the time of evaluation.