Fall 10-16-2019

The Value of Interactive Multimodal Online Higher Education Classrooms: Examining the Impact of Interactive Multimedia-Based Instructional Design (IMBID)

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A Dissertation by

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Irvine, California

School of Education

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Education in Organizational Leadership

October 2019

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ACKNOWLEDGMENTS

First and foremost, I would like to thank my son, Zachary. You are, and always will be, my “why” in life. At the age of seven, your will and determination are parallel to none and have inspired me, not only to begin this journey but to finish strong. Thank you for your patience and understanding as my attention has been divided these past two years.

“I'll love you forever, I'll like you for always, as long as I'm living my baby you'll be.”

—Robert Munch

In addition, I thank my parents who have given me the blessing of unconditional love and support. Mom, you taught me to never settle for what life hands me and to always reach for the stars. Dad, you pushed me beyond my limits and helped me see that limits are simply hurdles begging to be leaped over. Thank you for being my village. You took pictures at events I missed, kissed boo-boos when I couldn’t and made sure Zachary knew how much he is loved. There are simply no words.

To my Mom Squad, Steph and Nyssa, thank you for your unwavering friendship and support. Over the past two years you have fallen over yourselves to help me with Zachary when I needed to study and split bottles of wine with me when I needed to cry. I simply can’t imagine life without you.

I would also like to thank my boss and confidant for the last thirteen years, the fiercest person I’ve ever met, Murphy. They say the deepest bonds are forged in crisis — there is no one I’d rather walk through fire with. Through your mentorship and friendship, I have defined who I am and what I want in life. For these gifts, I am eternally grateful.

I extend my sincere gratitude to the leaders at Brandman University, Charles Bullock, Jeremy Korr, Ellen Derwin, Pat White, and Tod Burnett, for trusting and permitting me to conduct this study. To Sasha Crowley, thank you for being my righthand woman and co-creator of IMBID, for sharing my passion for equity in education, and for being a true friend. Lastly, thank you to the rest of my CII family for whom without your excellence and desire to test the limits of online education, this study would not have been possible.

I would also like to acknowledge the amazing faculty and staff of Brandman University's School of Education and Organizational Leadership Program. Your commitment to each student's success is undeniable. I can honestly say that this program not only made me a stronger leader, but a better person, friend, and mother.

To my OZ family, I can't imagine this journey without you. Dr. Buster you are more than a mentor, you are a true legend. To the rest of you, I expected to grow but never expected to gain a family. Thank you for accepting me for who I am and pushing me to be great!

Thank you to my committee members, Dr. Tami Capellino and Dr. Carlos Guzman, for your expertise and time. You have been my colleagues, teachers, and mentors and I could not have done this without your support.

Finally, to my Dissertation Chair, Dr. Doug DeVore. I have always admired your level-headedness, commitment to excellence, and all-around charisma. You've challenged me but also made me feel truly cared about on this dissertation journey. Thank you for sharing your wisdom, showing me that I was not alone, and for reminding me to enjoy the ride.

ABSTRACT

The Value of Interactive Multimodal Online Higher Education Classrooms:

Examining the Impact of Interactive Multimedia-Based Instructional Design (IMBID)

by Andrea Munro

Purpose: Despite their affordability and convenience, online courses have higher student failure and dropout rates than ground based-courses. The purpose of this quantitative causal-comparative single-case study was to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education.

Methodology: This quantitative research design used inferential statistics to analyze the research questions. The researcher selected 13 text-based courses that were redesigned to become interactive, multimedia-based courses. Archival student performance, engagement, and satisfaction data was abstracted from both the text-based and interactive multimedia-based versions of each course pair. The researcher then compared data sets using a two-sample z-test with independent groups.

Findings: Analysis of the data indicated a significant statistical difference in the levels of student performance, engagement, and satisfaction between students who completed the text-based version and those who completed the interactive, multimedia-based version of the courses. Additionally, the study also found that courses designed to be interactive and multimedia-based had higher student completion rates for significant assessments and student opinion surveys.

Conclusions: Based on the literature and findings of this study, it is concluded that due to online attrition, practitioners must first address the different ways in which students learn and engage on the web. By thoughtfully and intentionally leveraging high-quality multimedia technology and building social interaction around this content, online educators are better able to replicate the multimodal, active, and connected nature of learning.

Recommendations: To better understand the impact of IMBID on student retention, continued research must include student attrition data. By examining IMBID's impact among different content areas, degree levels, and teaching styles and by adding a control group, researchers will gain a deeper understanding of its implications across fields of study. Lastly, examining the impact of IMBID in other e-learning industries will determine the universal impact of course design on all web-based styles of learning.

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CHAPTER I: INTRODUCTION

The flexibility and affordability of online classrooms have attracted students at increasingly high rates, but will students stay? Evolving global industry, shifting generational needs, and rapidly advancing technology have driven the online education movement (Saba, 2011). This exponential growth fueled a bulk, text-based, single-modality approach to online course design that has resulted in attrition rates that far surpass those of ground-based courses (Herbert, 2006; Smith, 2010).

The online education movement dates back to the 1980s, but in the late ’90s, economic inequality, home computers, and high-speed Internet access drove a rapid demand for online college (US Department of Commerce, 2013). During this time, the office-place earnings gap between college graduates and those with high school diplomas widened at greater rates than ever before (Goldin & Katz, 2018). Meanwhile, at-home access and comfort levels with home computers and the Internet increased greatly (US Department of Commerce, 2013). As a result, the early 2000s saw an explosion in higher education institutions offering online learning solutions to students who now had access and drive (Bawa, 2016).

To meet the needs of the marketplace, these institutions called on faculty with limited computer and web-building skills to deliver a ground-based curriculum online (Deborah, 2006). The majority removed all interactive face-to-face components deemed not possible in the online platform. As a result, the majority of online courses featured text-based discussions, written papers and textbook readings (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005).

Today's online classrooms attract Millennial learners with drastically different expectations than their Baby Boomer and Generation X instructors (Corich, 2008). As these students are identified as active, kinesthetic, and visual learners, text-based courses do not appeal to them (Corich, 2008; Ke & Chavez, 2013). Having grown up in the era of the student-centered classroom (Zaker, 2013), Millennials expect a face-to-face classroom experience at a time and location that is convenient for them (Ke & Chavez, 2013). As a result of these mismatched expectations, online courses continue to show falling student retention rates (Bawa, 2016) with studies estimating online courses have a 10% to 20% higher failure rate (Herbert, 2006) and a 40% to 80% higher dropout rate (Smith, 2010) than traditional ground-based courses.

The research regarding factors affecting online higher education retention is expansive. One may argue a comparison of online to ground-based students is non-quantifiable due to their unique differences. However, some reports point to universal factors that may be addressed through online course design and delivery, which makes such comparisons possible. These findings suggest student performance (Bawa, 2016; Jensen, 2010; Tyler-Smith, 2006), engagement (Bawa, 2016; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010) and satisfaction (Bawa, 2016; Herbert, 2006; Jensen, 2010) in online courses are factors affecting retention that can be mediated through a multimodal, interactive and connected approach to online course design.

To address the needs of the online Millennial learner, educators have applied the principles of multimodality theory, active learning theory, and connectivism to craft interactive, multimedia-based online higher education courses that are more relatable, hands-on and multimodal (Oud, 2009; Zhang, 2006). Interactive Multimedia-Based

Instructional Design (IMBID) combines the use of multiple forms of media and interactivity to make online instruction and assessment multimodal and active. This study examined the impact of IMBID on student engagement, performance, and satisfaction in online higher education courses.

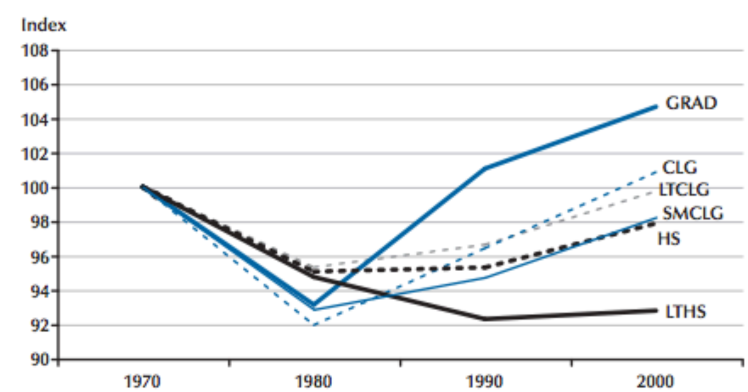
Background

Distance education dates back to the early 1700s and has evolved as technology has advanced and learner needs have shifted. As needs and technology evolved, so have delivery methods. Beginning with parcel post in early 1700s England, the need for distance education later grew exponentially in 1800s America, driven primarily by the Industrial Revolution (Verduin & Clark, 1991). The 1900s saw another boom during the Second World War as wartime technology and familial obligations created a copacetic supply-and-demand relationship (Online Schools Center, 2018). As a result, the earliest forms of text-based postal correspondence shifted to visual-based televised classrooms and eventually auditory-based radio broadcasts (Harting & Erhal, 2015; Kentnor, 2015; Online Schools Center, 2018). These single-modality focused delivery methods were limited in their ability to meet the needs of all learners and thus faced challenges related to student enrollment and retention (Online Schools Center, 2018).

Online education originated in the 1980s (National Center for Education Statistics (NCES), 2018). In the 1990s, the online movement, driven by employer demands and at-home technology access, began to take shape (Allen & Seaman, 2011; Shelton & Saltsman, 2005). These factors led to an online education marketplace boom and institutions struggled to produce the number of online courses in demand (Hartsell & Yuen, 2006; Krovitz, 2009).

Shifting Employer Demands

During the 1980s and1990s, as technological advancements began increasing exponentially, so did economic inequality (Hotchkiss & Shiferaw, 2010). The earnings of college graduates rose at a far greater rate than those of students who obtained only a high school diploma (Goldin & Katz, 2018). Seeking to better understand the origins of this gap, Hotchkiss and Shiferaw (2010) conducted an in-depth study to provide a "comprehensive, multidimensional decomposition of wages across both time and educational status", which was later published by the Federal Reserve. Figure 1 illustrates their findings.



NOTE: Hourly wages are indexed to the value of hourly wages in 1970. LTHS, less than high school; HS, high school; LTCLG, less than college; SMCLG, some college; CLG, college; GRAD, more than college.

Figure 1. Hourly Wages Across Education Levels (Hotchkiss & Shiferaw, 2010).

Additionally, the incomes of "top managers and professionals increased at a much faster rate than did those of ordinary workers" (Goldin & Katz, 2018, p 8). Upon conducting a deeper dive into the factors contributing to inflated salaries for college graduates, Hotchkiss & Shiferaw (2010) noted, "In both decades wage gains from increased demand for college graduates flowed through their increased use of technology rather than from merely an increase in demand for educated workers" (p 262). This shift meant greater demand for college degrees, a greater embrace of technology and increased affordability.

Technology Access

With businesses paying top dollar for not only college degrees but also technological skills, an increased value was placed on computing education. Once introduced, the Apple Macintosh computer generated a spike in the computer-to-student ratio, which shot to 1-92 in the United States. To make way for a seemingly imminent computer-led workplace, by 1985, schools began offering typing and computing courses. By 1988, laptops were introduced, and by 2003, all American schools had access to the Internet (NCES, 2018). This progression, coupled with the increase in disposable income, created a market for personal computers at home (US Census Bureau (USCB), 2013). US homes experienced a drastic upturn in demand between 2000 and 2010. In 2000, 51% of households reported owning a computer, laptop, handheld or other device and 41.5% reported having access to the Internet (USCB, 2013). These numbers grew to 76.7% and 71.1% by 2010 (USCB, 2013).

Rapid Demand for Online College

The pursuit of higher education coupled with the increasingly commonplace nature of personal computer & Internet access brought about a bustling online education marketplace (Allen & Seaman, 2011; Shelton & Saltsman, 2005). Soon online college programs began popping up all over the US (Bawa, 2016). While some critics had initial doubts as to the legitimacy of college degrees earned entirely online, these soon subsided as Harvard, Stanford, Oxford, the University of Texas, and other major universities began offering degrees entirely through online coursework (Davis & Dyckman, 2018). News of these high-caliber programs quickly spread, ensuring an "almost instant market for online educational offerings" (Davis & Dyckman, 2018, p 14). In fall 2005, 3.2 million students were reported to be taking at least one online course (United States Department of Education (USDE), 2013). Additionally, between 2007 and 2010, the number of students enrolled in online courses rose 18.8% per year (USDE, 2013). It soon became clear that the cost of fully online offerings was 36% less than that of ground-based courses and 28% less than that of blended options (Battaglino, Halderman & Laurans, 2012). Tempted by the bustling marketplace and the low cost-to-profit ratio online courses afford, masses of universities rushed to add online course listings to their catalog offerings. This high demand created a shortage of readily available online courses, which caused a rapid, bulk approach to online course development (Hartsell & Yuen, 2006; Michelich, 2002).

Text-Based Design

The demand for online programs created a hurried scramble for market share. As a result, instructors were called upon to quickly create online versions of their ground-based courses (Hartsell & Yuen, 2006; Krovitz, 2009). In most cases, universities utilized Learning Management Systems (LMS) to host online classrooms. These platforms provided closed networks that ensured student privacy, allowed for ease of grading, offered convenient attendance tracking, and provided fairly easy-to-use templates with editing capabilities (Deborah, 2006). Additionally, most LMS's offered text-based discussion forums, paper submission drop-boxes, e-mail capabilities, and customizable text editors for lecture content. While these platforms served schools well as a course repository, they were limited in the diversity of learning activities, including text-based learning activities and assessments (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005).

Millennial Learner

On the other side of the online higher education classroom, the needs of the online learner began to shift with the entrance of the Millennial learner between 2000 and 2016. This population, born between 1981 and 1996, was estimated at 71 million (Schroer, n.d.). Having grown up in homes with access to computers and high-speed Internet, these students were accustomed to a world at their fingertips (Corich, 2008; Ke & Chavez, 2013). Additionally, this group's coming of age aligned directly with the onslaught of mobile and adaptive technologies, which permitted a more on-the-go and personalized culture to exist (Redmond, 2017). This level of access and personalization influenced a K-12 classroom shift from the 19th-century factory model to 20th-century student-centered model, which they would come to expect from the 21st-century online college classroom (Lazarevic, 2011).

Multigenerational Online Classroom

With this new trend came multigenerational online higher-education classrooms where Baby Boomer instructors and Millennial students had vastly different educational styles and expectations (Corich, 2008). Millennials, described as active, kinesthetic and visual learners, desired adaptive, student-centered courses that allowed them to bypass mastered content and address only the areas they were lacking (Corich, 2008; Ke & Chavez, 2013). These students expected a face-to-face classroom experience but at a time and location that was convenient for them (Ke & Chavez, 2013). They also navigated technology with ease and had a low threshold for boredom (Corich, 2008; Ke & Chavez, 2013; Redmond, 2017).

In contrast, Baby Boomer instructors were still adapting to using technology. Accustomed to the professor-lecture model of teaching, they were slower to adjust their methods of instruction as technology was evolving at a record-breaking pace (Ke & Chavez, 2013). These variations caused concern, and age-related diversity began negatively affecting students' learning in online classrooms (Ke & Chavez, 2013).

Online Higher Education Attrition Rates

Proof of the impact of these variations is perhaps most evident in the startling attrition rates for online courses. The Accredited Online Colleges (2018) database lists 973 online accredited universities and 67,284 fully online programs with over 9 million student enrollments in the United States today. Since their inception, online courses have shown excessively high attrition rates in fully online programs compared with traditional ground-based classes (Heyman, 2010). The issue is twofold. Studies estimate that online courses have a 10% to 20% higher failure rate (Herbert, 2006) and a 40% to 80% higher dropout rate (Smith, 2010) than traditional ground-based classrooms.

Interactive Multimodal Connected Learning

To address these concerns, online educators have begun applying principles of multimodality theory, active learning theory, and connectivism. The goal has been to craft interactive, multimedia-based learning experiences that are more hands-on and multimodal, and thus more relatable to the Millennial learner (Cherrett et al., 2009; Delen, 2013; Hung, Kinshuk and Chen, 2012; Oud, 2009; Vural, 2013; Zhang, 2005;

Zhang, 2006). This approach is believed to positively impact student engagement, performance, and satisfaction in online higher education courses.

Multimodal Instruction

Multimodality (Kress, 2000) refers to the way people communicate and interact with each other, in terms of the textual, aural, linguistic, spatial, and visual resources—or modes—used to compose messages. In the classroom, this learning theory addresses the multiple modes of communicating information. It also addresses how performance is assessed with the understanding that no two students receive or deliver information in the same way.

The VARK Institute (Fleming & Mills, 2018) simplifies multimodality theory into four foundational sensory modalities—visual, aural, read/write, and kinesthetic—that they believe reflect the experiences of students and teachers. VARK is ideal for classifying multimodal learning activities, as its dimensions are intuitively understood, and its applications are practical (Fleming, 2013). In their 2017 study, VARK reported learning preferences of university and college students as roughly equal amongst all modalities, concluding that, to reach 100% of students, one must instruct and assess through all four modalities (see Table 1).

Table 1

Percentage of the VARK Options Chosen (Fleming & Mills, 2018)

	V	A	R	K	N=
Two-Year College	22.1	25.1	23.9	29.0	29306
Four-Year College	22.6	24.9	23.5	29.0	14061
University	22.7	24.7	24.0	28.5	27591

Note: Percentages in all rows do not add up to 100%.

Active Learning

Online courses that promote active learning focus more on developing students' skills than on transmitting information (Brame, 2016; Cherret et al., 2009; Moreno & Mayer, 2007). Active learning activities ask students to reflect, discuss or apply content learned (Cherret et al., 2009; Moreno & Mayer, 2007). Learning activities that employ this style require students to cognitively engage and access higher-order thinking rather than take more passive approaches to instruction, therefore deepening learning (Brame, 2016; Cherret et al., 2009; Moreno & Mayer, 2007). By applying new content to action, students connect new information and prior knowledge, thus extending their understanding (Brame, 2016; Cherret et al., 2009; Moreno & Mayer, 2007).

Connected Learning

Connected learning is grounded in the fundamentals of social learning theory, which states that people learn from one another via observation, imitation, and modeling (Bandura as cited in Soloway, Guzdial & Hay, 1994). Connectivism, a relatively new learning theory, builds upon traditional social learning theory and presents knowledge as living outside of the individual, in technology-mediated networks (Siemens, 2004). These networks may be human-to-human or human-to-artifact and are accessed via technology (Zaker, 2013).

Advancements in distance education have changed how students learn online. Today, the Internet enables students to access a seemingly infinite amount of historical, present and future information (Downes, 2008; Zaker, 2013). Online educators are able to leverage these new multimedia technologies to develop non-human, interactive learning activities that were previously unimaginable during the online education boom.

As a result, this technology-mediated instruction allows students to make connections across fields and disciplines similar to how they would in ground-based technical and clinical courses (Zaker, 2013).

Interactive Multimedia-Based Instruction

Interactive Multimedia-Based Instructional Design (IMBID) presents a theoretical-based prediction that online courses, developed using these multimodal, active and connected theoretical principles, will result in higher levels of engagement, performance, and satisfaction. Elements of this framework have been tested in single-case instances (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Parikh et al., 2011; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018 Vural, 2013, Zhang, 2005; Zhang et al., 2006). This narrow field of quantitative research has focused on the impact of individual, interactive multimedia-based lectures, quizzes, and learning modules. These activities allow students to engage with content in a variety of ways ranging from simple user control to more advanced interactivity such as simulation and game-based learning.

Interactive multimedia lecture videos that allow students to interact via user control access the visual (V), aural (A), and kinesthetic (K) modes. These learning activities have shown to have a positive impact on student performance and satisfaction when compared to other passive forms of lecture viewing (Delen, 2013; Zhang, 2005; Zhang et al., 2006). In addition, interactive multimedia assessments, where students interact via user control and in video quizzing, access the visual (V), aural (A), reading/writing (R), and kinesthetic (K) modes, increasing the positive impact on performance but also positively impacting levels of student engagement (Vural, 2013).

As the level of multimedia interaction grew in the frequency and depth of VARK modes, so did the impact. Ultimately, as the kinesthetic and social activities, game-playing, presentation, discussion, and simulation increased, so did the intensity of the results as they pertained to student performance (Chen, Hung, & Kinshuk, 2012) and satisfaction (Cherrett et al., 2009). A review of the literature points to the plausible conclusion that a positive relationship exists between the increased frequency of interactive multimedia-based instruction and student engagement, performance, and satisfaction in online higher education classrooms (Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Delen, 2013; Vural, 2013; Zhang, 2005; Zhang et al., 2006).

Statement of the Research Problem

Today, there exists a gap between what students want and how technology is being leveraged to engage students in the online classroom. This gap has created a sustainability epidemic facing the online higher education marketplace (Allen & Seaman, 2013). Despite the demand for and access to online courses being at an all-time high (NCES, 2015; US Census Bureau, 1997, 2007, 2017; Ryan & Lewis, 2017), student retention rates continue to fall (Accredited Online Colleges, 2018; Herbert, 2006; Heyman, 2010; Smith, 2010). Research points to the mismatch between text-based online instruction and the active multimodal needs of the Millennial learner **(**Corich, 2008; Ke & Chavez, 2013; Redmond, 2017; Schroder, n.d.).

It is clear that the needs of online learners are not being met. College students continue to drop or fail their online courses at far greater rates than ground-based courses

(Accredited Online Colleges, 2018; Herbert, 2006; Heyman, 2010; Smith, 2010). This is a cause for grave concern among chief academic officers who see student retention as a critical issue for the future of online education (Allen & Seaman, 2013).

A wealth of research has been conducted around the causes of student attrition rates in online higher education courses. Findings conclude student performance (Bawa, 2009; Jensen, 2010; Tyler-Smith, 2006), engagement (Bawa, 2009; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010), and satisfaction (Bawa, 2009; Herbert, 2006; Jensen, 2010) in online courses are factors affecting retention that may be mediated through the instructional design of the course. Existing case studies provide evidence that individual interactive multimedia-based learning activities positively impact student engagement, satisfaction, and performance (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Parikh et al., 2011; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018; Vural, 2013, Zhang, 2005; Zhang et al., 2006). However, there are no existing studies examining the impact of online courses designed to be fully interactive and multimedia-based on student engagement, satisfaction, and performance.

Purpose Statement

The purpose of this quantitative causal-comparative single case study was to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education.

Research Questions

The following research questions will be used to guide the purpose of this study:

1. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?
2. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?
3. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?

Significance of the Study

In 2015, the online learning industry in the United States reached $107 billion and is predicted to grow rapidly over the next decade (Hibbert, 2008). As the marketplace grows, so do concerns over student retention, with 67% chief academic officers considering online student retention a critical issue for the future of online education (Allen & Seaman, 2013). With such a high level of importance placed on the success of online higher education and evidence linking interactive multimedia-based instruction to student attrition, there is an increasing need to better understand precisely how learning takes place online.

Contributions to Literature

The scope of existing research into online interactive multimedia-based instruction is limited in sample size, interactivity type, and level of exposure. All but two studies examined data from less than 200 students (Esteves et al., 2018; Vural, 2013). Most studies focused primarily on user control, which requires a relatively low level of interaction and appeals to fewer modalities (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Vural, 2013, Zhang, 2005; Zhang et al., 2006). Some studies did require up to four types of interactivity but fell short of a truly interactive experience (Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018; Vural, 2013). Additionally, each study was single-case, examining only one element of a course rather than the entire course design (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Parikh et al., 2011; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018 Vural, 2013, Zhang, 2005; Zhang et al., 2006). While all studies aimed to measure the impact of interactive multimedia-based activities on student engagement, performance, and/or satisfaction, no one study identified the effects on all three of these elements.

Contributions to Practice

It is evident that university leaders have recognized the value of online education in its ability to extend reach and increase profits (Allen & Seaman, 2013). Interactive Multimedia-Based Instructional Design (IMBID) applies multimodal, active and connectivist learning theories to encourage students to actively engage with content to deepen learning in online higher education courses (Brame, 2016; Cherret et al., 2009;

Downes, 2008; Fleming, 2013; Fleming & Mills, 2018; Kress, 2000; Moreno & Mayer, 2007; Oud, 2009; Siemens, 2004; Soloway, Guzdial & Hay, 1994; Winterbottom, 2017; Zhang, 2006). Results from this study may be used to assist practitioners in the field to better understand how students learn, engage and enjoy learning via the web and thus inform how educators design and teach online.

Contributions to Policy

The production of quality, interactive educational media and e-learning tools incurs significant costs that many universities are hesitant to incur without fully understanding the impact (Hibbert, 2008). Findings from this study could link these investments to increased market share and sustainability. This understanding could better inform university leaders in developing university policies related to inclusion, universal access, and the return on investment in online learning technologies that will best support these initiatives.

Definitions

The following operational definitions of terms are provided to give clarity of meaning as used throughout the study.

Active Learning. Learning activities ask students to reflect, discuss, or apply content learned (Cherret et al., 2009; Moreno & Mayer, 2007).

Connected Learning. Presents knowledge as living outside of the individual, in technology-mediated networks (Siemens, 2004), which may be human-to-human or human-to-artifact and are accessed via technology (Zaker, 2013).

Interactive, Multimedia-Based Online Instruction. Courses where students are asked to interact with multimedia content consistently throughout the course. Examples of these interactions include:

- **User Control.** Students engage with multimedia content through user control functions that allow them to play, pause, stop, rewind, search, etc.
- **View and Reflect.** Students engage with media content and respond with a video or text reflection.
- **View and Discuss.** Students engage with media content and engage in a group discussion either via video or via text.
- **View and Present.** Students engage with media content and create a visual presentation.
- **In-Video Quizzing.** Students answer questions embedded inside the media content they are engaging with. This is often linked to the gradebook and student performance is tracked.
- **Hotspot Media.** Students mouse over or click on media content to learn more about the item.
- **Game-Based Learning.** Students participate in gameplay to achieve learning outcomes, thus winning the game.
- **Simulation.** Students complete an artificial representation of a real-world process to achieve learning outcomes.
- **View and Do.** Students engage with media content and replicate actions on their own as they are demonstrated for them.

Multimodal Learning. Multiple modes of communicating information and assessing student performance with the understanding that no two students receive information in the same way (Kress, 2000).

Multimedia Active Connective Learning (MACL). The overlap between multimodality, interactivity, and connective learning theories used to provide a framework for how interactive multimedia-based online courses impact student engagement, performance, and satisfaction.

Student Engagement. The level of active involvement students have in the course as it pertains to the time spent in the class and the level of activity within the collaborative course tools.

Student Performance. The students' ability to meet the desired Program Learning Outcomes (PLOs).

Student Satisfaction. Self-reported contentment as it relates to the design of the course only.

Text-Based Online Instruction. Includes content primarily delivered in written form. These courses also feature student assessments that are delivered primarily in written form, e.g. research papers, discussion forums, journal responses, and wiki posts (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005).

VARK. Four foundational sensory modalities—visual, aural, read/write, and kinesthetic—that reflect experiences of students and teachers (Fleming & Mills, 2018).

Delimitations

The delimitations clarify the boundaries of the study (Simon, 2011). The goal of this study was to evaluate the effects of interactive multimedia-based instruction on student performance, engagement, and satisfaction in online higher education courses. With 973 online accredited universities in the United States (Accredited Online Colleges, 2018), there was only one, to the researcher's knowledge, where fully online courses were systematically redesigned to apply interactive multimedia-based instructional design. This qualification was essential to the study because the researcher needed access to historical data on student performance, engagement, and satisfaction for the same courses delivered in both text-based and interactive multimedia-base modalities. Therefore, to conduct this research, the researcher narrowed the scope of the study to select courses based on the following factors:

- Online Delivery: The university selected offered 77 fully online degree-granting programs and over 600 fully online courses (Brandman, 2018).
- Dual Modality: The university selected ran an interactive multimedia-based course design pilot where multiple text-based courses were converted to the interactive multimedia-based format. Thus, text-based and multimedia-based versions of the same courses were available for sampling.
- Student Performance Data: The university selected collected student performance data via a significant assessment which measured the students' mastery of the Program Learning Outcomes.
- Student Engagement Data: The university selected for this study deployed courses via a Learning Management System that collected student engagement data in the form of number of student submissions within collaborative tools and time spent inside course content areas.

- Student Satisfaction Data: The university selected for this study collected student satisfaction data as it related to the design of the course.
- Interactive Multimedia-Based Instructional Design: The university selected for this study offered courses that employ interactive multimedia-based content and assessment consistently throughout the courses. These courses contained weekly interactive multimedia-based instructional content and required students to connect with their peers and/or instructors via weekly interactive multimedia-based learning activities.
- Data Access: Due to the researcher's employment status at the selected university, she was granted access to the ex post facto student satisfaction, engagement and performance data.

The sample was further delimited to 13 course pairs. For each course pair, a traditional text-based version of the course was compared to the matching interactive multimedia-based version of the same course to create a pool of 26 course samples consisting of 80 live sections that were taught between 2015 and 2019. Considering the average class size for this university, the researcher utilized a nonprobability purposeful sampling of 812 students from which secondary student performance and engagement and data were collected and analyzed, and 580 students from which secondary student satisfaction data was collected and analyzed.

Organization of the Study

This study is presented in five chapters. Chapter I introduces the study, provides an overview of distance education, presents the statement of the problem, the significance of the problem, definitions of terms, and study delimitations. Chapter II reviews the literature on distance education and how the online higher education movement came to be, the challenges the online higher education marketplace faces and approaches to addressing such challenges as they relate to increasing student performance, engagement, and satisfaction. Chapter III describes the methodology used in the study, including the population and sample as well as the criteria used to select study samples. Chapter IV details the findings of the study and data analysis. Chapter V provides an interpretation of the data, draws conclusions based on the analysis, suggests implications for action, and offers recommendations for further research.

CHAPTER II: REVIEW OF THE LITERATURE

Introduction

In the early 2000s, employer demands for technology-savvy college graduates, coupled with the convenience of at-home Internet access, drove the online education movement (Allen & Seaman, 2011; Goldin & Katz, 2018; Hotchkiss & Shiferaw, 2010; Saba, 2011). As a result, the online marketplace became flooded with students as universities hastily sought faculty willing and able to create web-based course offerings (Deborah, 2006). This rush to balance the supply and demand deficit fueled a bulk, text-based approach to online course design (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005).

Today's U.S. online education marketplace includes 973 online accredited universities and 67,284 fully online programs with over 9 million student enrollments (Accredited Online Colleges, 2018). While popular among students for their convenience and affordability, since their inception, web-based courses have shown disproportionately higher dropout and failure rates than traditional ground-based classes (Herbert, 2006; Heyman, 2010; Smith, 2010). These attrition rates are a growing concern among chief academic officers with 67% identifying online student retention as a critical issue for the future of online higher education (Allen & Seaman, 2013).

Due to the high level of importance placed on student retention, the breadth of research into factors affecting attrition is expansive. A review of literature, synthesized in Appendix A, points to universal factors that may be facilitated through online course design and delivery. Mirroring the conception of the online education movement in the 1990s was a shift from the traditional lecture approach to the student-centered classroom model (Angelo, 1999). As these students began enrolling in online courses, their expectations of a student-centered experience were met with a text-based, instructor-centered delivery model (Ke & Chavez, 2013; Northrup, 2001). This misalignment negatively impacted student performance, engagement, and satisfaction in online courses and thus adversely affected student retention (Bawa, 2016; Herbert, 2006; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010). Interactive Multimedia-Based Instructional Design (IMBID) leveraged multimedia technology and applied learning theory to generate student-centered online courses that aimed to increase student performance, engagement, and satisfaction.

To better understand the plausible impact of IMBID, a thorough review of literature was conducted on the following topics:

1. a summary of the literature on the historical foundations in online education;
2. theoretical foundation on educational theories related to increasing student engagement, performance, and satisfaction in online higher education classrooms; and
3. a summary of the literature on the role of interactive multimedia-based learning activities in online higher education classrooms.

Historical Perspective: Forms and Drivers of Distance Education

Education in the United States originated with the one-room schoolhouse. This multi-grade classroom was authentically differentiated and paced to meet the needs of students and the community (Kentnor, 2015). In the late 1800s, the Industrial Revolution birthed a factory approach to schooling, known as the Prussian model (Kentnor, 2015). In 1892, The National Education Association appointed the Committee of Ten to establish a standard grade-level curriculum model to be used across the country (Ornstein & Levine, 1993) and thus the standardized model took flight. This standards-based approach provided an efficient model for educating the masses (Verduin & Clark, 1991).

"In the decades following the Civil War, the United States emerged as an industrial giant" (Kentnor, p. 24, 2015). Bridges were being built, railways were expanding, and America was growing along with the demand for petroleum refining, steel manufacturing, and electrical power. Technological advancements and machinery made manual jobs obsolete and created a demand for a newly skilled workforce of engineers, machine operators, and financiers (Ornstein & Levine, 1993). As the desire for college degrees grew, so did the familial obligations, financial strain, and geographic barriers to attending a traditional university (Verduin & Clark, 1991); thus, distance education found renewed traction.

Distance education, a term dating back to the 1700s, referred to a method of instruction whereby students and instructors were physically separated (Kentnor, 2015). The goal was to provide educational opportunities to meet the needs of underrepresented populations and those without access to traditional education (Kentnor, 2015). In its earliest forms, distance education utilized postal correspondence and later evolved with the invention of the radio, television, and the Internet (Roffe, 2004; Verduin & Clark, 1991). Today's version of distance education is known as online education (Allen & Seaman, 2011; Shelton & Saltsman, 2005).

Parcel Post

Correspondence courses were the earliest form of distance education in America. In this model, students received lessons and exercises through the mail, or some other device, and, upon completion, returned them for evaluation and grading (Kentnor, 2015). While it originated in England as early as the 1700s, the Chautauqua Movement of the 1870s is responsible for its popularity and acceptance for adults in America (Harting & Erhal, 2015).

"Chautauqua" is an Iroquois word meaning "two moccasins tied together" (Harting & Erhal, 2015). The name was fitting as it resembled the shape of the Chautauqua Lake, located in southwest New York, where the first educational assembly took place, as well as the distance between student and learner tied together by the Chautauqua Institution (Kentnor, 2015). Originated as a training program for Sunday school teachers, the Chautauqua University was established in 1883 and expanded to include general-education four-year certificate programs through correspondence (Harting & Erhal, 2015).

William Harper Rainey, using Chautauqua University's model, was the first to offer college-level correspondence courses at the University of Chicago (Harting & Erhal, 2015; Kentnor, 2015; Online Schools Center, 2018). By 1893 the university offered 350 correspondence courses, enrolling 3,000 students, taught by roughly 125 instructors (Rumble, 1986). The Prussian standards-based model impacted the design of this new home-based style of learning as well. In 1915, the National University Extension Association formed in an effort to formalize this alternative education model (Kentnor, 2015). As a result, a more systemized approach to correspondence education allowed institutions to meet growing demands.

Radio

In 1894, Guglielmo Marconi invented the radio (Kentnor, 2015). Originally, the concept of wireless communications as a competitive technology was met with criticism. During World War I, the radio's widespread military use identified a marketplace.

In 1919, the University of Wisconsin began WHA, the first federally licensed radio station dedicated to educational broadcasting (Engel, 1936). By the 1920s, classrooms across America began incorporating radios into penmanship, accounting, history and arithmetic lessons (Harting & Erhal, 2015; Online Schools Center, 2018). By 1930, 40% of households reported owning a radio (US Census Bureau, 2016) and over 170 universities had attained broadcast licenses (Kentnor, 2015).

Due to the lack of regulation and the increasing popularity of the idea, broadcast courses found themselves battling radio interference. In an attempt to regulate the broadcasting industry, Congress established the Federal Radio Commission (United States Congress, 1927). However, by then it was too late. The regulatory issues, coupled with the onset of the Great Depression in 1929, significantly impacted higher education and educational radio. By that time, only 20% of educational radio correspondence channels still existed (Kentnor, 2015).

Television

Radios were not the only military-influenced technology transforming classroom teaching; overhead projectors, initially used for US military training preceding World War II, quickly spread to schools (Harting & Erhal, 2015; Verduin & Clark, 1991). This was followed by silent films and films with sound, which leveraged visual and auditory media to augment written and spoken instruction. This movement towards multimodal classroom instruction continued to blossom through the mid-1900s with the incorporation of TV in 1939, and headphones for language instruction in the 1950s.

Television was also leveraged in distance education. In 1935, the University of Iowa began testing television as a medium for delivering course content (Harting & Erhal, 2015). By the late 1950s, 83% of households reported owning a television (US Census Bureau, 2016). In response to this widespread access, the Ohio University, University of Iowa, Iowa State University, Kansas State University, the University of Michigan, and American University began offering the first televised college courses in the US (Harting & Erhal, 2015; Online Schools Center, 2018).

Fearful of experiencing the same market-saturation issue that had faced broadcast radio, educators petitioned the Federal Communications Commission (FCC) to reserve television channels for the exclusive use of education. In 1966, the FCC responded by reserving over 600 channels (Kentnor, 2015). Of the channels reserved, one-third were licensed to colleges and universities (US Census Bureau, 2016).

Despite the access and popularity of college broadcasting networks, the use of television to facilitate distance education remained stagnant (Verduin & Clark, 1991). The lack of growth was blamed primarily on poor production quality and pedagogy (Harting & Erhal, 2015). This single-modality, teacher-centered approach did not hold students' attention, resulting in low viewership (Harting & Erhal, 2015). By the mid- to late 1970s, the British Broadcasting Company (BBC) began to set a standard for American television course developers to follow, but by then the potential for online course offerings began to take shape (Verduin & Clark, 1991).

Computerized Instruction

In 1960, The University of Illinois created an intranet for its students called Programmed Logic for Automatic Teaching Operations or PLATO (Kentnor, 2015). This system of linked computer terminals allowed students to access course materials and listen to recorded lectures. This program operated on thousands of terminals across the globe and would later be used as the conceptual foundation for designing social media (Peterson, 2017).

The intranet cleared a path for acceptance of computing technology in the education arena. In 1964, BASIC was developed at Dartmouth College with the intent of teaching computer programming (Online Schools Center, 2018). By 1967, the first mobile learning device, the handheld calculator, was developed by Texas Instruments, allowing every student access to computing technology. Additionally, the 1970s and 80s popularized game-based learning with *Lemonade Stand*, and *Oregon Trail* allowed students to interact with classroom content in ways previously unimaginable (Heick, 2017). Accessibility and multimodality were not the only computerized advantages being accessed in schools. In the 1970s, classrooms all over the world began using Scantron forms to automatically grade multiple-choice tests and fundamentally change how learning was assessed.

As high-powered computer access, broadband communications, and digital video were developed in the 1980s and 1990s, economic inequality hit an all-time high (Harting & Erhal, 2015). The earnings of college graduates rose at a far greater rate than those who obtained only a high school diploma (Goldin & Katz, 2018). Additionally, the incomes of "top managers and professionals increased at a much faster rate than did those of ordinary workers" (Goldin & Katz, 2018, p 8). This shift meant greater demand for college degrees and increased affordability.

The popularity of computer technology was also growing at this time. This progression, coupled with the increase in disposable income and the backing from federal and state government distance learning initiatives, created a market for telecommunications in education (Harting & Erhal, 2015). Once introduced, the Apple Macintosh computer generated a spike in the computer-to-student ratio, which shot to 1-92 in the US. To make way for a seemingly imminent computer-oriented workplace, by 1985, schools began offering typing and computing courses (US Census Bureau, 1997). Laptops were introduced in 1988 and by 2003, all American schools had access to the Internet (Davis & Dyckman, 2018).

As classroom-based technology access grew, so did access to technology at home. Per the US Census Bureau 2015 report, computer and Internet access in US homes experienced a drastic upturn. In 1984, 8% of households had a computer, and by 2000, that number grew to 51%. The latest numbers, collected in 2015, reported 87% of households owning a computer, laptop, handheld, or other device. In 1997, the US Census Bureau collected data on Internet use indicating that 18% of households used the Internet. A decade later, in 2007, this percentage had more than tripled to 62% and later increased to 77% in 2015.

The Online Learning Marketplace

The advancements in computing solutions and widespread access to the Internet generated a plausible, mainstreamed sustainability for online learning in the 21st century. Universities and corporations recognized that web-based instruction offered adult learners and institutions advantages that traditional ground-based models simply could not. In a struggle for a share of the market, institutions proactively sought to meet the evolving needs of learning.

The e-learning marketplace began to take form in the 1990s. By the early 2000s, most major universities began adding online courses and programs to their catalogs, but the online learning marketplace did not end there. Soon thereafter, in response to employee requests, businesses began offering web-based corporate training options. In 2012, Udacity and EdX disrupted the market, offering hundreds of free Massive Open Online Courses or (MOOCs) (Online Schools Center, 2018). In recent years, challenged to provide a flexible outcomes-based alternative to the traditional credit-hour model, the industry responded with Competency Based Education (CBE) (Nodine, 2016).

Online Universities

With personal access to the Internet at an all-time high and the lure of lucrative promotions for college-educated, technology-proficient employees, universities were quick to recognize the earning potential of online courses (Goldin & Katz, 2018; Hotchkiss & Shiferaw, 2010). In addition to the influx of potential students, online courses meant higher profit margins. Battaglino, Halderman, and Laurans (2012) estimated the cost per pupil of fully online schools to be 36% less than that of brick-and-mortar public schools and 28% less than that of blended schools.

In 1989, the University of Phoenix, an online-only institution, became the largest private university in America (Bawa, 2016; Online Schools Center, 2018). Soon thereafter, the 1990s and early 2000s saw an explosion in higher education institutions offering blended and fully online education solutions to students who now had access to the Internet. Between 2007 and 2010, the number of students enrolled in online courses rose 18.8% (United States Department of Education, 2013).

In the years spanning 2012 through 2016, while overall higher education enrollment decreased (Figure 2), online distance education enrollments continued to rise (Figure 3) (Allen, Allen, Seaman & Seaman, 2018).

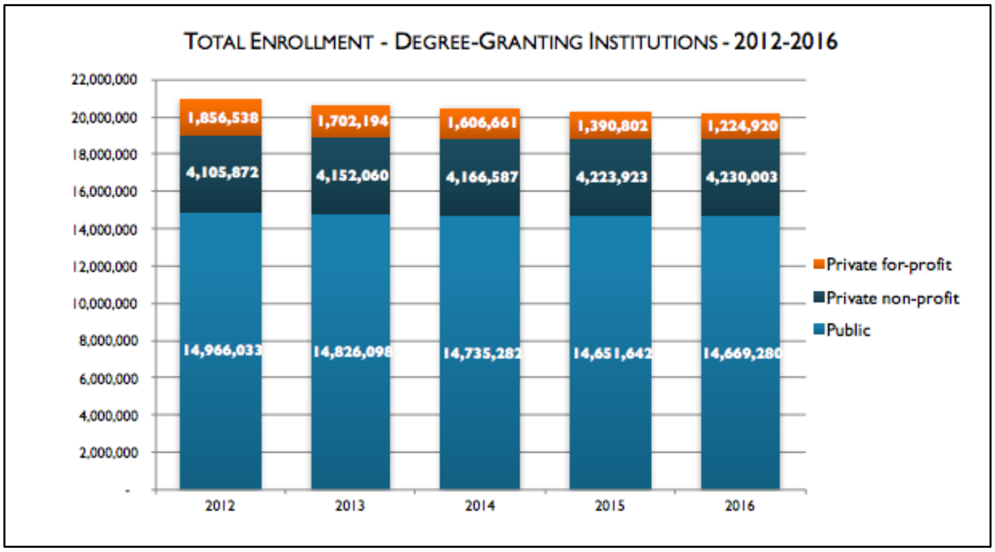


Figure 2. College Enrollment 2012-2016. (Allen, Seaman & Seaman, 2018, p 4).

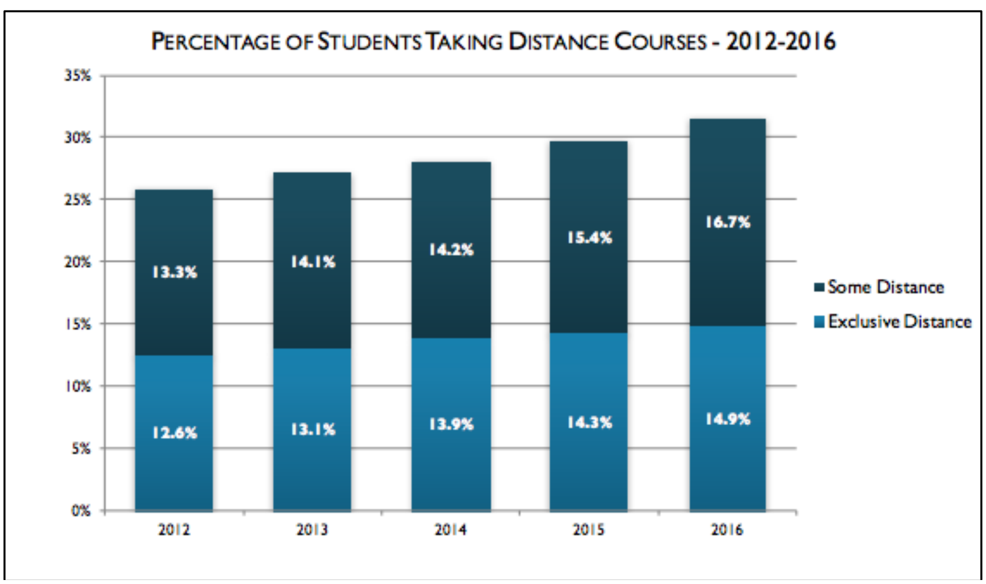


Figure 3. Online College 2012-2016 (Allen, Seaman & Seaman, 2018, p 4).

In 2016, the number of students enrolled in at least one online course reached 6.4 million (Allen, Seaman & Seaman, 2018). Just two years later, in 2018, The Accredited Online Colleges database listed 973 online accredited universities, offering 67,284 fully online programs, with over 9 million students enrolled across the United States Accredited Online Colleges (2018).

Web-Based Corporate Training

Universities were not the only institutions leveraging the advantages of e-learning. Corporations, who in the 1980s pioneered the use of computers to train employees (Kentnor, 2015), by 2000 began utilizing online learning as an integral part of corporate training (Bawa, 2016). Students who had once completed online college courses now desired the same convenience and personalized learning in their professional development (Bonk, 2002). E-learning offered businesses enhanced productivity, increased motivation, reduced training costs, increased autonomy, and increased quality (Bawa, 2016; Northrup, 2018). As a result, organizations delivering web-based training had "better chances at business and financial gains" (Bawa, 2016, p. 1).

By 2002, a study conducted by Jones Knowledge, Inc. and CourseShare.com surveyed 201 trainers, instructional designers, training managers, and human resource personnel on the demand and application of corporate web-based training (Bonk, 2002). The study reported 75% of the organizations used Internet-based delivery systems for training. In addition, 68% employed multimedia programs as a means to enhance engagement and understanding. Between 2005 and 2010, businesses employed integrated talent management suites, capable of hosting multimedia-rich content, to host employee training (Bersin, 2018).

Around 2012, another trend in professional training occurred with the coining of micro- and macro-learning. Where macro-learning referred to the more traditional online classroom experience, micro-learning referred to quick, topic-based video tutorials, and interactives that immediately addressed on-the-job questions (Bersin, 2018). In 2015, a study conducted by LinkedIn, of 4,000 employees from over 700 organizations, found that 68% of employees prefer to learn at work, 58% prefer to learn at their own pace and 49% prefer to learn at the point the information is needed (Bersin, 2018). Additionally, the study revealed that the average employee has only 24 minutes a week for formal learning (Bersin, 2018). Micro-learning met the needs of this workforce.

Massive Open Online Courses (MOOCs)

MOOCs were online courses available for anyone to enroll (Allen & Seaman, 2017; Coursera, 2018; Pappano, 2012). They were known for their large class sizes and typically free or extremely low price tags. They also made waves in news headlines when top-tier schools began joining the MOOC marketplace.

In 2010, fueled by the popularity of online education, Stanford professors Andrew Ng and Daphne Koller introduced the world to MOOCs through an open source web-based platform known as Coursera (Allen & Seaman, 2013; Coursera, 2018). Coursera, the largest MOOC provider, partnered with elite universities including Princeton, Brown, Columbia, and Duke to provide "universal access to the world's best education" (Coursera, 2018). By 2017, Coursera reportedly offered 2,400 courses in 29 countries and 10 languages (Pappano, 2012). They were quickly followed by edX, the nonprofit start-up from Harvard and the Massachusetts Institute of Technology (Pappano, 2012).

Even more impressive than their Ivy League partnerships, MOOCs' enrollment statistics have continued to show impressive growth year over year. As of 2017, the number of students enrolled in at least one MOOC reached 78 million (Shah, 2018). At the time, it was estimated that 800 universities contributed to at least one MOOC a year (Shah, 2018). Top MOOC providers included Coursera at 30 million users, edX at 14 million users, XuetangX at 9.3 million users, Udacity at 8 million users and FutureLearn at 7.1 million users (Shah, 2018).

The instructional design model applied the use of video lecture content as a means of providing flexible instruction to large class-sizes (Hibbert, 2016). This largely popularized the use of multimedia in traditional online course design. Today, the MOOC marketplace is expansive and commonly used as a marketing tool for universities who wish to allow prospective students a sampling of their course offerings (Hibbert, 2016).

Competency-Based Education (CBE)

CBE has been linked to the long-standing efforts of outcomes-based K-12 classrooms (Nodine, 2016). This model, similar to those engaged in military, technical and apprenticeship settings, first identified outcomes that reflected the competence or skills required, then focused on the student actions or performance that embodied mastery of said competencies (Nodine, 2016). This model was designed to address the higher-order thinking skills associated with Bloom's Taxonomy (Northrup, 2001). While instructor-centered activities primarily focused on building students' ability to remember, understand and apply concepts taught, competency-centered education concentrated on students' ability to analyze, synthesize, and evaluate the information to construct meaning (Nodine, 2016; Zaker 2013).

Competency-based online programs allowed students to progress by mastering competencies (Zaker, 2013, p 2). In this highly structured instructional design model, students began a course by completing a pretest to assess prior knowledge of desired competencies (Zaker, 2013). Students who proved mastery of all or some competencies via the pre-assessment bypassed the learning activities associated with them and focused only on the components of the course that they did not yet know (Nodine, 2016; Zaker, 2013). This enabled students to progress through responsive course content at their own pace with instructors acting as facilitators, coaches, and graders (Nodine, 2016; Zaker, 2013). Those with extensive prior knowledge had the potential to greatly accelerate the timeframe to earn their degree as compared to more traditional credit-hour approaches.

This self-directed student-centered alternative gained popularity for CBE (Zaker, 2013). In the spring of 2014, 52 higher education institutions were offering CBE programs (Nodine, 2016). By the winter, that number quadrupled and by the fall of 2015, the U.S. Department of Education reported that 600 postsecondary institutions were offering CBE programs (Nodine, 2016). At the same time, enrollment growth for online courses, while still greater than that of ground-based courses, began to taper off into single digits (Allen & Seaman, 2013, p. 47). In contrast, enrollments in the largest competency-based university, Western Governors University, were doubling year over year (US Department of Education, 2013).

Factors Affecting Online Learning

Within the booming and diverse e-learning marketplace, there were universal factors affecting online learning. Whether it be the online college classroom, corporate training, MOOC or CBE course, the needs of the Millennial learner and the shift toward student-centered learning were significant variables affecting attrition. To account for these factors, one must first understand the role they played in the online marketplace.

Text-Based Design

The demand and excitement for online learning solutions created a frenzy for market share. As a result, instructors, trainers, professors, and course developers were called upon to create online versions of their ground-based courses quickly (Hartsell & Yuen, 2006; Krovitz, 2009). Most institutions utilized some form of Learning Management Systems (LMS) to house their online curriculum. What they provided in ease of use, grading, and structure, they lacked in creativity (Deborah, 2006). As a result, online learning activities lacked diversity and consisted primarily of text-based learning activities, such as reading textbooks or web-based articles, participating in written discussion forums, and written reflections and assessments, such as written exams and research papers (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005).

Student-Centered Learning

The origins of student-centered classrooms date back to 1990 and framed the classroom model most Millennials experienced growing up (Angelo, 1999). Prior to this transference, the instructor-centered classroom model employed "didactic instruction," where learning was an information-transmission process from teachers who possessed knowledge to students who did not (Soloway, Guzdial & Hay, p. 16, 1994). As access to computers and the Internet grew, so did the range of sources of knowledge (Zaker, 2013).

Alternatively, student-centered classrooms employed connectivism, social learning, and constructivism, shifting the focus from the teacher to the student (Soloway, Guzdial & Hay, 1994). The goal of this model was to address the higher-order thinking skills associated with Bloom's Taxonomy (Northrup, 2001). While instructor-centered activities primarily focused on building students' ability to remember, understand, and apply concepts taught, student-centered learning concentrated on students' ability to analyze, synthesize, and evaluate the information to construct meaning (Northrup, 2001). A comparison of this shift is illustrated in Figure 4 below.

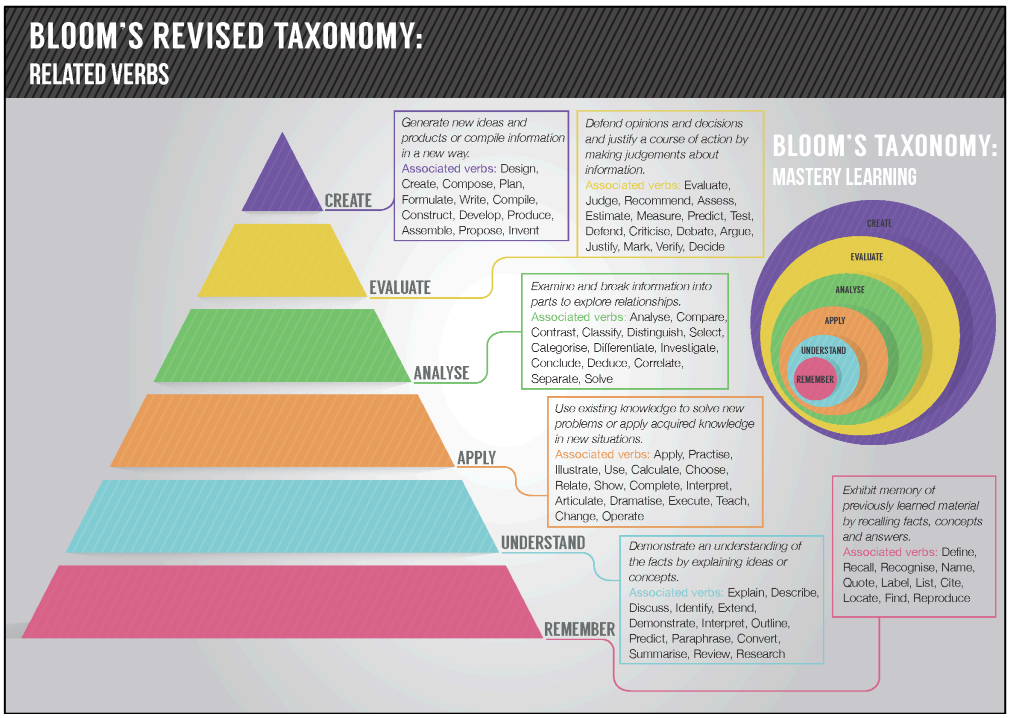


Figure 4. Unpacking Bloom's Taxonomy: Pedagogy in Online Learning (Langdon, 2017).

Millennial Learner

Born between 1977 and 1994, the Millennial learner population was estimated at 71 million (Schroer, n.d.). This is nearly double to triple the size of any other single generation and thus has heavily influenced the education system. Having grown up in homes with access to computers and high-speed Internet, these students were accustomed to a world at their fingertips (Corich, 2008; Ke & Chavez, 2013). Additionally, this group's coming of age aligned directly with the onslaught of mobile and adaptive technologies, which allowed a more on-the-go, personalized culture to exist (Redmond, 2017). The disproportionate level of access and personalization influenced a K-12 classroom shift from a teacher-focused model to a student-focused model (Angelo, 1999).

Due to their size, the Millennial generation had a significant impact on shaping how businesses marketed online (Redmond, 2017). The same is true for their influence on the education system. In addition to their large size, Millennials had unique patterns of learning styles that shaped both the K-12 and higher education systems as they progressed through them. Millennials preferred short lectures, practical application, online delivery and mini-tests (Corich, 2008). These students, described as active, kinesthetic, and visual learners, desired adaptive courses that allowed them to bypass mastered content and address only the areas they were lacking (Corich, 2008; Zaker, 2013). They expected a face-to-face classroom experience but at a time and location that was convenient for them (Corich, 2008; Redmond, 2017). They were also motivated by the use of technology, had a low threshold for boredom and short attention spans (Corich, 2008; Ke & Chavez, 2013; Redmond, 2017).

With the onslaught of the Millennial online learners came multigenerational classrooms where instructors and students had vastly different learning styles and expectations (Corich, 2008). In contrast to the technology-savvy Millennial learner was often the Baby Boomer instructor, professor, and/or course designer. These experts in their field preferred a linear approach to teaching and addressing course learning objectives (Corich, 2008). They preferred face-to-face communication, were slower to acclimate to new technologies, and were generally described as rule-followers (Corich, 2008). The variations between the teaching and learning styles of these two generations were concerning because age-related diversity affected an individual's learning in online classrooms (Ke & Chavez, 2013).

Online Education Attrition Rates

While year over year, online learning intuitions, including the University of Phoenix, continued to show increased enrollments, this was not the case for many traditional brick-and-mortar institutions, who attempted to join the online learning marketplace and did not survive (McMahon, 2013). In many cases, these traditional universities, excited to join the online marketplace, "did so without the full support of the faculty, ultimately impacting the sustainability of their online programs" (Carlson & Carnevale, p. 95, 2001). In addition to a lack of faculty buy-in, students struggled in online courses, causing them to withdraw, drop out, or fail.

Despite increasing enrollment rates, online courses at thriving institutions continued to show receding student retention rates (Bawa, 2016). Many studies were conducted to identify the causes of this attrition. While some argued that there were unique differences between online and ground-based students that make a comparison impossible, others pointed to universal factors that could possibly be addressed through online course design and delivery.

Some students reported feeling unengaged due to the "sense of isolation attached to learning alone" (Bawa, 2016; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010). Others found the student-driven constructivist model provided course content but then left students to solve complex problems on their own, affecting their overall performance (Bawa, 2017; Jensen, 2010; Tyler-Smith, 2006). Another pointed to the failure on the part of educators to recognize the pedagogical differences that exist between online and face-to-face environments, which left students feeling dissatisfied with their experience (Bawa, 2016; Herbert, 2006; Jensen, 2010; Kentnor, 2016).

Theoretical Foundation for Online Learning

To address student performance, engagement, and satisfaction affecting e-learning attrition, instructional designers have applied the principles of multimodality theory, active learning theory, and connectivism to craft interactive, multimedia-based courses that are more relatable, hands-on and multimodal (Oud, 2009; Zhang, 2006). Interactive Multimedia-Based Instructional Design (IMBID), also known as Interactive Multimedia-Based E-Learning, combines the use of multiple forms of media and interactivity for the purpose of making instruction and assessment multimodal and active. This method of design is believed to positively impact student engagement, performance, and satisfaction in online higher education courses.

Multimodal Instruction

Multimodality (Kress, 2000) refers to how people communicate and interact with each other, in terms of the textual, aural, linguistic, spatial, and visual resources—or modes—used to compose messages. In the classroom, this learning theory addresses the multiple modes of communicating information to students with the understanding that no two students receive information in the same way. It also points to a variety of methods for assessing student learning outside of the traditional written approaches.

The VARK Institute (Fleming & Mills, 2018) simplifies multimodality theory into four foundational sensory modalities—visual, aural, read/write, and kinesthetic—that they believe reflect the experiences of the students and teachers. VARK is ideal for classifying multimodal learning activities, as its dimensions are intuitively understood, and its applications are practical (Fleming, 2013). In their 2017 study, VARK reported learning preferences of university and college students as roughly equal across all modalities, with a slight increase towards kinesthetic learning (see Table 1).

Active Learning

Active learning is based on constructivism, which emphasizes that knowledge is constructed within a learner's understanding (Winterbottom, 2017). Online courses that promote active learning focus more on developing students' skills than on transmitting information (Brame, 2016). Most often, active learning activities ask students to reflect, discuss or apply content learned. Learning activities that employ this style require students to cognitively engage and access higher-order thinking than more passive approaches to instruction, therefore deepening learning (Cherret et al., 2009). By applying new content to action, students make connections between new information and their prior knowledge, thus extending their understanding.

Most active learning models are infused with learner-centered principles (Soloway, Guzdial & Hay, 1994). Instructors play the role of facilitator rather than the all-knowing deliverer of information. This approach provides scaffolding for students as they deepen their understanding of new concepts while actively applying them to new situations. Interactive, multimodal learning environments are those that center around learners' actions. In short, the defining feature of interactivity is responsiveness to the learner's action during learning (Moreno & Mayer, 2007).

Active learning is inquiry-based, where the learner's role is that of the problem-solver. Students pose scientific questions, analyze evidence, connect evidence to prior knowledge, draw conclusions, and reflect upon their findings (Winterbottom, 2017). Due to the social nature of this style of instruction, students will often discuss and/or collaborate with others along the way. Active learning fosters understanding, problem-solving, and real-world application.

Connected Learning

Interactive Multimedia-Based Instructional Design (IMBID), while active and multimodal, is also highly social. Connected learning is grounded in the fundamentals of social learning theory (Bandura as cited in Soloway, Guzdial & Hay, 1994), which states that people learn from one another via observation, imitation, and modeling. Connectivism builds upon traditional social learning theory and presents knowledge as living outside of the individual, in technology-mediated networks (Siemens, 2004). These networks may be human-to-human or human-to-artifact and are accessed via technology of some kind.

Advancements in distance education have changed how students learn online. Today, the Internet enables students to access a seemingly infinite amount of historical, present and future information (Downes, 2008). Instructional Designers are also able to leverage these new multimedia technologies to develop non-human, interactive, learning activities that were previously unimaginable during the online education boom. This technology-mediated instruction allows students to make connections across fields and disciplines similar to how they would in ground-based technical and clinical courses.

Conceptual Framework

Multimodal instruction, active learning and connected learning combined form the foundation for the Multimodal Active Connective Learning (MACL) Framework.

MACL suggests that an overlap exists between multimodality, interactivity, and connective learning theories. Combined, as illustrated in Figure 5, these fields offer a language and a framework to understand how interactive multimedia-based online courses increase student engagement, performance, and satisfaction.

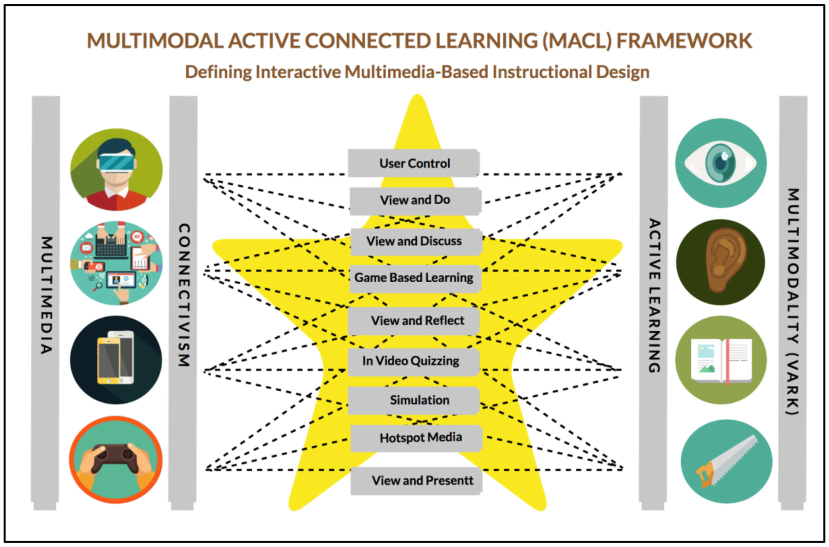


Figure 5. The Multimedia Active Connective Learning (MACL) Framework

Interactive Multimedia-Based Instruction Defined

Interactive Multimedia-Based Instructional Design (IMBID) was developed by the researcher and piloted at Brandman University in 2018. In accordance with the university's vision, "to be the recognized leader in the evolution of adult learning," and their belief in continuous course renewal and innovation, the goal of IMBID was to meet the needs of the Millennial adult learner. The university used Quality Matters to ensure their online courses were designed to be educationally sound, accessible to all learners, and technology-rich. Additionally, they required all instructors to provide in-time "substantive feedback" to students. As outlined in their Instructional Design for Engaged Adult Learning (iDeal) white paper (2010), they found that adult learners wanted an accelerated course format that utilized the convenience and resources of technology with the benefits of face-to-face instruction. IMBID used immersive and interactive multimedia to simulate face-to-face instruction, make learning interactive and support substantive feedback. Additionally, students could choose when, where and how often they wanted to engage with the content.

Multimedia

Multimedia instruction utilized more than one medium of expression to communicate course content. In online classrooms, these materials were web-based and consisted of both written or spoken text as well as visuals. Examples of multimedia learning activities included video lectures, infographics, diagrams, animations, slideshows, presentations, podcasts, and screen captures. This approach to online instruction was supported by multimodal learning theory, which stated that deeper learning takes place "from words and pictures than from words alone" (Mayer, 2014).

The most commonly leveraged form of multimedia instruction used in online classrooms was video. Online course videos encompassed the following: screencasts, which captured presentation content from a desktop with the instructor's narration; talking heads, which captured the instructor's physical presence and narration; lecture captures, which captured the presentation materials, the instructor's narration and physical presence; and animations, which incorporated animated presentation content along with narration. Due to the remote nature of e-learning classrooms, these videos were often utilized to convey information traditionally delivered by the instructor during classroom time. Studies have found the multimodal design elements of this form of instruction positively influenced students' ability to derive meaning from abstract and/or difficult concepts (Hibbert, 2016; Hofman & Wieling, 2010; Lazaravic, 2011; Ozan & Ozarslan, 2016).

To learn more about the instructional design components influencing "compelling video," Columbia University examined video analytics from a video hosting platform (Hibbert, 2014). Findings showed that engagement in the course increased due to the perceived increased instructor presence made possible using instructional video (Hibbert, 2014; Koivula, 2018; Lazarevic, 2011). Additionally, data analytics revealed that video viewership increased when videos were directly connected to course assignments, had a high production quality, included both audio and visual elements, and were four minutes or less. For the purpose of this study, the researcher utilized the MACL conceptual framework principles to classify the types of multimodal multimedia-based Learning Activities utilized in IMBID as they relate to the visual, aural, reading/writing and kinesthetic (VARK) modes (Fleming & Mills, 2018). The results are listed in Table 2.

Table 2

Multimodality Learning Theory Applied via IMBID Learning Activities

Modality	Learning Activity	Description
VAR	User Control	Students engage with multimedia content through user control functions that allow them to play, pause, stop, rewind, search, etc.
VAR	View and Reflect	Students engage with media content and respond with a video or text reflection.
VAR	View and Discuss	Students engage with media content and engage in a group discussion either via video or via text.
VAR	View and Present	Students engage with media content and create a visual presentation.
VARK	In Video Quizzing	Students answer questions embedded inside the media content they are engaging with. This is often linked to the gradebook and student performance is tracked.
VARK	Hotspot Media	Students mouse over or click on media content to learn more about the item.
VARK	Game-Based Learning	Students participate in gameplay to achieve learning outcomes, thus winning the game.
VARK	Simulation	Students complete an artificial representation of a real-world process to achieve learning outcomes.
VARK	View and Do	Students engage with media content and replicate actions on their own as they are demonstrated for them.

Interactivity

While the findings above supported the notion that multimedia-based instruction positively impacted student performance and engagement, additional research into the impact of building in interactivity has shown that substantial learning takes place when learners interact with multimedia content to make meaning (Mayer, 2014). Interaction, as it is used for this study, was most often achieved through multimedia interactions that required students to engage in reflection, discussion, and/or application. The researcher utilized MACL principles to classify the types of multimedia-based reflection, discussion, and application interactions students engaged within IMBID classrooms. The results are listed in Table 3.

Table 3

Active Learning Theory Applied via IMBID Learning Activities

Active	Multimodal	Learning Activity	Description
Reflection	VAR	User Control	Students engage with multimedia content through user control functions that allow them to play, pause, stop, rewind, search, etc.
	VAR	View and Reflect	Students engage with media content and respond with a video or text reflection.
Discussion	VAR	View and Discuss	Students engage with media content and engage in a group discussion either via video or via text.
	VAR	View and Present	Students engage with media content and create a visual presentation.
Application	VARK	In Video Quizzing	Students answer questions embedded inside the media content they are engaging with. This is often linked to the grade book and student performance is tracked.
	VARK	Hotspot Media	Students mouse over or click on media content to learn more about the item.
	VARK	Game-Based Learning	Students participate in gameplay to achieve learning outcomes, thus winning the game.
	VARK	Simulation	Students complete an artificial representation of a real-world process to achieve learning outcomes.
	VARK	View and Do	Students engage with media content and replicate actions on their own as they are demonstrated for them.

Today, almost all classrooms employ active learning strategies. What made IMBID unique was the utilization of technology-mediated learning activities to connect learners to content online. Applying the principles of connectivism, students gained knowledge and understanding through student-to-human interaction as well as student-to-artifact interaction, all via computer-mediated means. Using the MACL framework, the researcher classified the ways in which students connect with these artifacts and humans in IMBID classrooms. The results are listed in Table 4.

Table 4

Connectivism Learning Theory Applied via IMBID Learning Activities

Connective	Active	Multimodal	Learning Activity	Description
Student-to-Artifact	Reflection	VAR	User Control	Students engage with multimedia content through user control functions that allow them to play, pause, stop, rewind, search, etc.
		VAR	View and Reflect	Students engage with media content and respond with a video or text reflection.
Student-to-Human	Discussion	VAR	View and Discuss	Students engage with media content and engage in a group discussion either via video or via text.
		VAR	View and Present	Students engage with media content and create a visual presentation.
Student-to-Artifact	Application	VARK	In Video Quizzing	Students answer questions embedded inside the media content they are engaging with. This is often linked to the gradebook and student performance is tracked.
		VARK	Hotspot Media	Students mouse over or click on media content to learn more about the item.
		VARK	Game-Based Learning	Students participate in gameplay to achieve learning outcomes, thus winning the game.
		VARK	Simulation	Students complete an artificial representation of a real-world process to achieve learning outcomes.
		VARK	View and Do	Students engage with media content and replicate actions on their own as they are demonstrated for them.

Existing Studies: Interactive Multimedia-Based Instruction Applied

The MACL conceptual framework illustrated the theoretical-based prediction that online courses, developed using IMBID, would result in higher levels of engagement, performance, and satisfaction. Elements of this framework have been tested in single-case instances. This narrow field of quantitative research focused on the impact of individual, interactive multimedia-based lectures, quizzes, and learning modules. These activities allowed students to engage with content in a variety of ways, from simple user control to more advanced interactivity such as simulation and game-based learning.

Multimedia-Based Reflection

Reflection is defined as a means of transforming obscure and doubtful experiences to those that are clear and coherent (Dewey, 1933). Reflective learning has been widely accepted as an effective means of building student knowledge in classrooms. Traditional reflective-based assignments have ranged from written journals to reflective papers, observation notes, and SOAP notes. By modifying these traditional assignments to incorporate interactive multimedia, students access content through visual (V), aural (A), and reading (R) modes of VARK (Fleming & Mills, 2018).

Interactive lecture tools like Learn by Asking (LBA) have been used to generate multimodal video-based lectures (Zhang et al., 2006). The LBA content, shown in Figure 6, allowed students to see a video of the instructor, hear what he said, and read associated slides and lecture transcripts. Students could also search the transcript to locate a specific point within the lecture to review. Additionally, students could interact with the content through user control by pausing, stopping, rewinding, replaying and fast-forwarding.

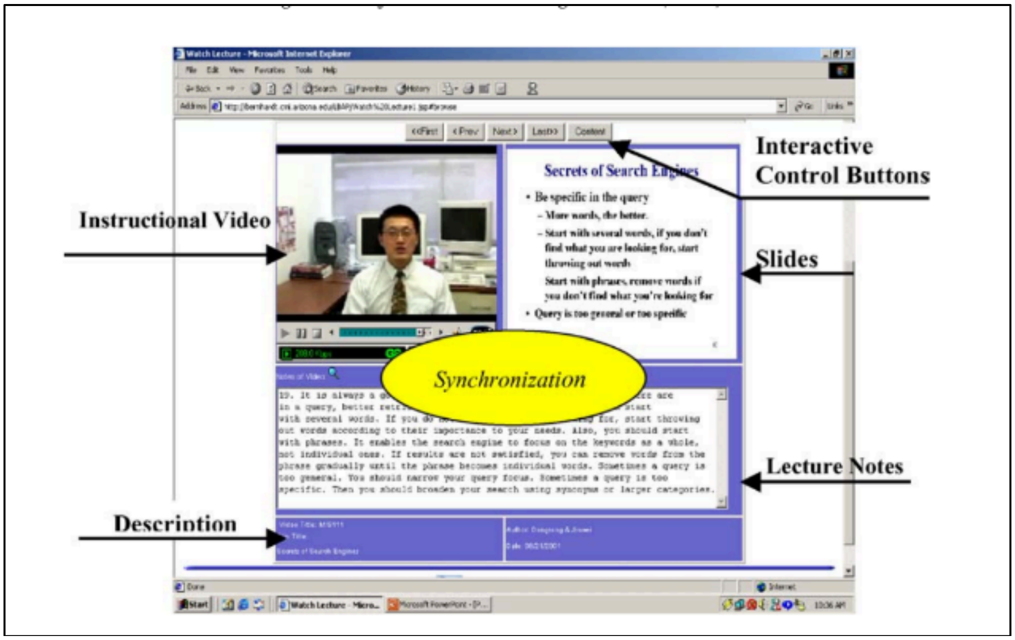


Figure 6. The LBA Classroom (Zhang et al., 2006, p 15–27)

Manipulating the media allowed the student to make meaning of the content as they viewed, re-viewed, and reflected (Delen, 2013; Zhang, 2005; Zhang et al., 2006). Despite their relatively low interactivity level, these learning activities have shown to have a positive impact on student performance and satisfaction when compared to other passive forms of lecture viewing (Delen, 2013; Zhang, 2005; Zhang et al., 2006).

In addition to user control, video journals have been used in higher education online classrooms (Henderson, 2016; Parikh et al., 201; Pritsker & Blackwell, 2013). In this activity, students leveraged media to create their own reflective video journals. While written reflection has proven to be a successful practice in deepening understanding, video journaling was a relatively new approach that allowed students to physically see their growth over time while more clearly communicating their experiences (Henderson, 2016; Parikh et al., 201; Pritsker & Blackwell, 2013).

The use of video has been widely used in the science and medical professions due to the low reproducibility of studies published in written journals (Henderson, 2016).

The use of medical video journals made its debut in 2006 with the *Journal of Visualized Experiments* (JoVE) (Henderson, 2016; Pritsker & Blackwell, 2013). JoVe was birthed from Princeton researcher Kira Henderson while she was conducting complex research into the field of stem cells (Henderson, 2016; Pritsker & Blackwell, 2013). The goal of JoVe was to more clearly share the experiment process so others could replicate it (Pritsker & Blackwell, 2013). In addition to clarifying meaning and thus performance in online classrooms, many video journals became a two-way asynchronous conversation between instructors and students that expanded the perceived instructor presence and increased student satisfaction (Parikh et al., 2011; Henderson, 2016). Lastly, students in counseling- and psychology-focused career fields expressed that they were more engaged in the assignments because this type of reflection felt more authentic and connected more deeply to their futures as practitioners (Parikh et al., 2011).

Multimedia-Based Discussion

Interactive multimedia discussions were built on the same principles as video journals but required students to engage in reflective dialogue with one another (Borup et al., 2013; Chen, Hung, and Kinshuk, 2012; Ching & Hsu, 2013). Text-based threaded discussions and synchronous student presentations have been as common in online classrooms as textbooks have been in traditional classrooms (Deborah, 20016; Young, 2017). These collaborative activities have allowed participants to externalize and share knowledge, experiences, and practice, but for many students, participating in online class discussions and viewing multiple hours of live presentations felt like a repetitive chore (Young, 2017).

Multimedia-based discussion and presentation activities have been most often completed asynchronously through threaded forums using tools such as VoiceThread, Flipt, and Kaltura (Borup et al., 2013; Ching & Hsu, 2013). Unlike written posts, these activities accessed the (V), aural (A) and reading/writing (R) modes through a student-to-student connection. Students who participated in these activities reported that audio and video interaction helped build connections with their peers (Borup et al., 2013; Ching & Hsu, 2013). Additionally, the multimodal nature of these activities enabled learners to communicate emotion, personality, and other nonverbal cues conducive to better understanding and interpreting meanings (Borup et al., 2013; Ching & Hsu, 2013).

Multimedia-Based Application

The principles of Piaget's constructivism stated that learning took place when students actively constructed or created their own representation of knowledge. In ground-based, constructivist classrooms, students would be asked to apply their skills and knowledge to complete simulated activities of real-world scenarios, collaborate with peers to solve real-world problems, or participate in mock debates. In e-learning classrooms, instructors faced unique barriers to incorporating this style of instruction, most often resulting in a default to written papers and exams. To address this challenge, in-video quizzing, hotspot media, game-playing, and simulation activities were employed to provide students with opportunities to apply their knowledge to authentic real-world scenarios (Borg et al., 2018; Chen, Hung, & Kinshuk, 2012; Delen, 2013; Esteves et al., 2018; Kleinheksel, 2014; Peterson-Ahmad, 2018; Sopiano, et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018).

Interactive multimedia assessments, where students interacted via user control and in-video quizzing, accessed the learner through visual (V), aural (A), reading/writing (R) and kinesthetic (K) modes by pausing and posing questions throughout the video. Students were provided with immediate feedback on their responses. This additional level of assessment and immediate feedback increased the positive impact of user control on performance and student engagement (Vural, 2013). Similar interactive modules integrated hotspot activities, allowing students to learn more about a given item or respond to questions by hovering over images (Delen, 2013). When compared to simply watching the video, learning modules that incorporated note-taking, hotspot media, and in-video quizzing activities also produced superior learning performance (Delen, 2013).

As the level of multimedia interaction grew in the frequency and depth of VARK modes, so did the impact (Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Esteves et al., 2018). Simulation and game-based learning studied shared many similarities. Both forms were highly interactive, incorporated roleplay, were goal-oriented, and asked students to apply their understanding and skills. Simulations were typically based on realistic scenarios while games were mostly based on fantasy. Studies of the implementation of these activities in online classrooms detected even greater correlations between media, interactivity and student outcomes.

The adoption of gaming principles to traditional classrooms built cognition, reflection, and strategizing and problem-solving skills. The online application of digital games to an educational curriculum has provided opportunities to examine their impact on the learning process. Due to the relatability of online games, many students found these experiences to be more enjoyable (Cherrett et al., 2009) and spent more time engaging in them than in traditional text-based instructional practices (Esteves et al., 2018). Additionally, students who spent significant time completing the games performed higher in post assessments than peers (Esteves et al., 2018).

Providing safe and realistic simulations for practitioners has been an essential component of ground-based higher education practicum courses (Borg et al., 2018). For online classrooms, providing virtual web-based simulations could be an effective way to facilitate the transition from what students know to what they can do. Virtual simulations have proven effective at teaching abstract concepts within urban and rural planning (Wang et al., 2018) and virtual experiments via Microelectronics Web Lab (Wu, 2018), resulting in higher knowledge mastery and ability training.

The fields of education and nursing, challenged to prepare practitioners to meet ever-increasing standards and practice, leveraged virtual simulation to provide pre-service students, who are not ready for or do not have access to physical students/patients, an opportunity to apply what they are learning in the classroom. Students who completed mock healthcare emergencies, via FIRST2ACTWebTM (Borg et al., 2018) and Digital Clinical Experience (Kleinheksel, 2014), and mock classroom scenarios, via TeachLiveE (Peterson-Ahmad, 2018), showed improved recognition and learning efficiency over those who did not. Ultimately, as the multimedia requirement for students to apply knowledge kinesthetically increased, so did the intensity of the results pertaining to student performance (Borg et al., 2018; Chen, Hung, & Kinshuk, 2012; Delen, 2013; Esteves et al., 2018; Kleinheksel, 2014; Peterson-Ahmad, 2018; Wang et al., 2018; Wu, 2018), engagement (Esteves et al., 2018; Vural, 2013), and satisfaction (Cherrett et al., 2009).

Conclusion

When reviewing the literature, it is evident that university leaders have recognized the value of online education both in its ability to extend reach and increase profits (Allen & Seaman, 2013). Evidence supports the link between student attrition in online higher education courses and student performance (Bawa, 2016; Jensen, 2010; Tyler-Smith, 2006), engagement (Bawa, 2016; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010) and satisfaction (Bawa, 2016; Herbert, 2006; Jensen, 2010). Interactive Multimedia-Based Instructional Design (IMBID) applies multimodal, active and connectivism learning theories to encourage students to actively engage with content to deepen learning in online higher education courses.

The literature review explored research that supports the positive impact of single-case, interactive multimedia-based learning activities, yet further research is required to better understand the implications of these findings on Interactive Multimedia-Based Instructional Design (IMBID). Additionally, the scope of existing research into IMBID is limited in sample size, interactivity type and level of exposure. Zhang et al. (2006) conducted the largest study with 318 students, which is more than double the remaining sample sizes. Most studies focused primarily on user control, which requires a relatively low level of interaction and appeals to fewer modalities (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Vural, 2013; Zhang, 2005; Zhang et al., 2006). Some studies did require up to four types of interactivity but fell short of a truly interactive experience (Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Delen, 2013; Esteves et al., 2018; Henderson, 2016;

Kleinheksel, 2014; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018; Vural, 2013). Additionally, each study was single-case, examining only one element of a course versus the entire course design (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Parikh et al., 2011; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018 Vural, 2013, Zhang, 2005; Zhang et al., 2006)). While all studies aimed to measure the impact of interactive multimedia-based activities on student engagement, performance, and/or satisfaction, no one study identified the effects on all three of these elements.

The literature review provided information regarding successful interactive multimedia-based learning activities as it pertains to enhancing the learning experience for students. The MACL framework, coupled with the single-case studies, provided a jumping-off point for delving deeper into the impact of a fully interactive multimedia-based course design as it relates to student engagement, performance, and satisfaction. Results from this study were used to assist practitioners in the field to better understand how students learn, engage and enjoy learning via the web.

Synthesis Matrix

A synthesis matrix (Appendix A) was developed from a review of the academic literature. The matrix cross-referenced existing studies examining the impact of interactive multimedia-based instruction on student engagement, satisfaction and/or performance. The matrix also indicates the design of the studies, including their methods, sample size, and data analysis. Lastly, the matrix presents patterns in the types and levels of interactivity and multimodality.

CHAPTER III: METHODOLOGY

Overview

This chapter details the quantitative research method employed to address the impact of Interactive Multimedia Design on student performance, engagement, and satisfaction to determine if interactivity with visual media positively impacts student learning. A restatement of the purpose of the study and the research questions are provided, and will be followed by a discussion of the variables studied, both dependent and independent. A description of the population and the sample studied are identified. The instruments used to collect the ex post facto data are reviewed. Finally, the chapter will conclude with a discussion of the limitations of the research, and an overall summary of the chapter.

Purpose Statement

The purpose of this quantitative causal-comparative single-case study is to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education.

Research Questions

The following research questions will be used to guide the purpose of this study:

1. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?

2. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?
3. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?

Research Design

This quantitative single-case study utilized a causal-comparative, also referred to as ex post facto, research design. The causal-comparative design seeks to find relationships between two variables after an action has already occurred (Salkind, 2010). Questions in causal-comparative studies ask, "What is the difference in?" about a dependent variable between two or more groups (LAERD, 2012). The researcher's goal was to determine whether one or more variables, known as the independent variable(s), affected the outcome of the other variable or variables, known as the dependent variable(s) (McMillan & Schumacher, 2010, p 224). The advantages of using this design included developing a better understanding of historical events, identifying causes for existing conditions and informing future decision-making (Salkind, 2010).

This design was appropriate because the researcher investigated the relationship between two variables, text-based online higher education courses and interactive-multimedia-based online higher education courses. This study asked, "What is the difference in?" student performance, engagement, and satisfaction among students who completed a traditional text-based version of the course and those who completed the interactive multimedia-based version. To answer these questions, the researcher examined whether the independent variables, or course modalities, affected the outcome of three dependent variables: student performance, student engagement, and student satisfaction. The control group in this study was comprised of students who completed the text-based version of the course. The intervention group in this study was comprised of the students who completed the interactive multimedia-based version of the course.

Population

A population is defined as a "group of elements, whether individuals, objects or events, that conform to specific criteria and to which we intend to generalize the results of the research" (McMillan & Schumacher, 2010, p 129). The Accredited Online Colleges (2018) database listed 973 online accredited universities and 67,284 fully online programs with over 9 million students across the United States. This represented the population for this study.

Sampling Frame

A sampling frame is a subset of the population further identifying delimiting factors related to the actual study participants (McMillan & Schumacher, 2010). The student population size at the university selected for this study during the 2017-2018 academic year was reported to be 7,812 students (National Center for Education Statistics (NCES), 2018). Of this, 3,677 were undergraduates and 4,135 were graduate students (NCES, 2018). Based on this data, the population of students enrolled in this university was 66% female and 34% male (NCES, 2018). Veterans or active service members made up 30% of the student population (NCES, 2018). Students identified that 82% live in California and 18% live out-of-state (NCES, 2018). To enroll in this university, students must have a minimum of 12 college credits previously obtained. This student population was viewed as diverse in ethnicity (Table 5) with a high concentration of Millennial learners, ages 24-38 (Table 6).

Table 5

Student Ethnicity Distribution for 2017 (NCES, 2018).

Student Ethnicity	Percentage
Hispanic	13%
Asian	5%
White or Caucasian	57%
Black or African American	10%
Pacific Islander	1%
American Indian	1%
Two or More Races	2%
Unknown or International Students	11%

Table 6

Student Generation Distribution for 2017/18 Academic Year (Brandman, 2018).

Student Age	Percentage
18-23	10%
24-38	58%
39 and Over	32%

The university offered 77 fully online degree-granting programs and over 600 fully online courses (Brandman, 2018). At this university, 62% of students were enrolled exclusively in online courses with an additional 21% of students reporting taking some fully online courses. Regarding online class sizes, 81% of courses had fewer than 20 students while 19% have between 21-49 students (NCES, 2018).

Sample

The study sample included students enrolled in traditional text-based online courses and students enrolled in interactive multimedia-based online courses. McMillan and Schumacher (2010) describe nonprobability sampling as sampling that does not involve random selection. Purposeful sampling, as defined by McMillan and Schumacher (2010), is the practice of selecting subjects with certain characteristics. The benefits of this style of sampling, according to Patton (2015), includes "information-rich cases to study", resulting in data that "will illuminate the inquiry question being investigated" (p. 264).

This study applied a nonprobability, purposeful sampling approach to identify a survey population. This determination was made because the selection consisted only of online higher education students who completed interactive multimedia-based courses. Additionally, the researcher sought a location where text-based courses had been converted to interactive multimedia-based courses to best identify the impact of this design approach. The single-case university selected for this study was located in southern California and offered online courses in a variety of majors. This university was selected because, to the researcher’s knowledge, this was the only location where traditional text-based fully online courses were systematically redesigned to apply the interactive multimedia-based instructional design. Thus, historical data on student performance, engagement, and satisfaction were available for the same courses delivered in both text-based and interactive multimedia-base modalities. Additionally, this location was deemed ideal due to its large Millennial population and data access afforded to the researcher as an employee.

Determining an appropriate sample size required consideration of the study's purpose and focus, data-collection strategy, availability, and the quantity of data needed (McMillan & Schumacher, 2010). To conduct this study, the researcher sampled student data from courses based on the following criteria: they ran fully online, ran in a traditional text-based format for a minimum of one year prior to being converted to the interactive multimedia-based format, had a significant assessment—also known as a signature assignment, contained weekly interactive multimedia-based instructional content and required students to connect with their peers and/or instructors via weekly interactive multimedia-based learning activities. In all, 13 course-pairs meeting these requirements were selected from a variety of fields of study and degree levels. For each course pair, a traditional text-based version of the course was compared to the matching interactive multimedia-based version of the same course to create a pool of a minimum of 26 courses from which 80 live sections were sampled.

This resulted in a nonprobability purposeful sampling of 1570 students. In an effort to increase reliability, reduce sample size, and allow for equal course representation, the researcher first removed all zero values and then employed proportional stratified random sampling. In doing so, the researcher aimed to collect student performance and engagement data from 35 students who completed the text-based version and 35 students who completed the interactive multimedia-based versions of the course for each of the 13 course-pairs where possible. For course pairings where data from 35 students was not present, the researcher selected the greatest possible quantity of student data and matched the quantity from both courses within the pairing. This approach resulted in a proportional stratified random sampling of 812 students from which 406 completed the text-based version of the course and 406 completed the interactive multimedia-based version of the course for each course pair. Table 7 represents the outcomes of this sampling approach per course and Appendix B presents the outcomes per course section.

Table 7

Student Performance and Engagement Survey Sample Data Selection

	Text-based Population N=	Text-Based Sampled N=	IMBID Population N=	IMBID Sampled N=
Course 1	50	35	50	35
Course 2	105	35	99	35
Course 3	97	35	89	35
Course 4	47	22	22	22
Course 5	36	35	62	35
Course 6	63	35	37	35
Course 7	69	35	42	35
Course 8	102	16	16	16
Course 9	83	33	33	33
Course 10	75	20	23	20
Course 11	63	35	68	35
Course 12	53	35	55	35
Course 13	56	35	75	35
Total	899	406	671	406

The availability of student opinion data was significantly lower than that of student performance and engagement data due to the response rates of the student opinion survey. As a result, the researcher employed nonprobability purposeful sampling and utilized all of the available student opinion data, resulting in 328 samples from students who completed the text-based version of the course and 252 samples of students who completed the interactive-multimedia-based version of the course for a total of 580 samples. Table 8 represents the results of this data selection process.

Table 8

Student Satisfaction Survey Sample Data Selection

	Text-based Population N=	Text-Based Sample N=	IMBID Population N=	IMBID Sample N=
Course 1	50	14	50	18
Course 2	105	32	99	35
Course 3	97	36	89	29
Course 4	47	20	22	7
Course 5	36	14	62	30
Course 6	63	26	37	14
Course 7	69	21	42	15
Course 8	102	37	16	4
Course 9	83	24	33	9
Course 10	75	34	23	10
Course 11	63	27	68	23
Course 12	53	21	55	31
Course 13	56	22	75	27
Total	899	328	671	252

Note: Average response rate for text-based = 36% and IMBID = 38% (Appendix H).

In summation, a combination of nonprobability purposeful sampling and proportional stratified random sampling was used to pinpoint the sampling frame from which archival data was collected. This multi-tiered approach, illustrated in Figure 7, resulted in a survey population of 812 students from which student performance data was extracted and analyzed, a population of 812 students from which student engagement data was extracted and analyzed, and a population of 580 students from which student satisfaction data was extracted and analyzed.

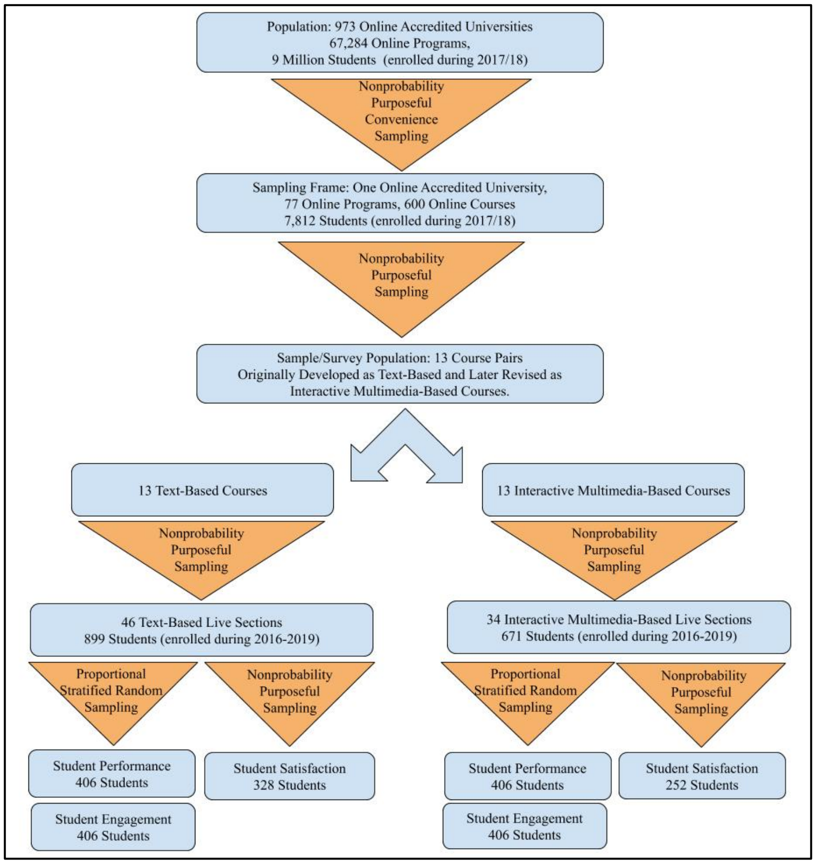


Figure 7. Multi-Tiered Sampling Approach

This sample size aligns with Gay and Airasian's (2003) sample size table recommendations for a population of 9,000,000. Per Gay and Airasian (2003), to obtain a 95% confidence level and statistical significance of $p \leq 0.05$, a sample size of at least 384 was needed (p 113). Although random sampling is optimal to ensure accuracy

(Creswell, 2014), in cases where the research purpose limits the scope of the study, nonprobability is used (McMillan & Schumacher, 2010). Due to the strict criteria of the study and the limited availability of courses meeting these requirements, the researcher selected a nonprobability, purposeful sample. Purposefully selecting this population and sampling of courses provided optimal data for the researcher to analyze (Patten, 2012).

Instrumentation

The instrumentation for this causal-comparative study included databases employed by the university that housed ex post facto, student performance, engagement, and satisfaction data. This data was collected using historical reports, which are used to provide records of past events (McMillan & Schumacher, 2010). Student performance data was collected using two Significant Assessment (SA) databases. Student performance data was collected using reports produced by the Learning Management System (LMS). Student satisfaction data was collected using from historical Student Opinion Surveys (SOS) deployed regularly by the university (Appendix D). From these systems, reports were generated to collect mean student data related to student performance, engagement, and satisfaction from both the text-based version of the course and the interactive multimedia-based version of the course.

Significant Assessment (SA) Database

Student performance was analyzed using data collected from Significant Assessments (SA), which were used to measure student mastery of program objectives. The university utilized two SA databases to house, assess and track student performance on SAs. These databases offered a report that produced student scores on a given SA per course section. This data was collected and compared to address the differences pertaining to Research Question 1, student performance on SAs.

Courses examined in this study that were offered through the schools of Arts and Sciences, which collected this data via Turnitin (Brandman University Assessment Office (BUAO), 2016). Turnitin is a tool that allows students to submit assignments via the web. Once submitted, Turnitin reports plagiarism detection findings to the instructor, who is then able to provide personalized feedback and assess student writing via the use of built-in rubrics (Turnitin, 2019). For this study, Turnitin was used as a plug-in within the Learning Management System (LMS), Blackboard. Students submitted papers via Turnitin that were then evaluated using a pre-built rubric. These rubrics were developed by the faculty, using the university's rubric template (Appendix C). The rubrics were designed, using a four-point scale, to measure the students' mastery of a given Program Learning Outcome. They were then built into the Turnitin assignment. Thus, all student SA submissions were evaluated using an identical rubric (BUAO, 2016).

Courses examined in this study that were offered through the school of Education collected SA data via LiveText (BUAO, 2016). LiveText is a web-based assessment management tool that allows students to submit assignments via the web (Livetext, 2017). Like Turnitin, students submitted papers via LiveText that were then evaluated using a pre-built rubric. These rubrics were developed by the faculty, using the university's rubric template (Appendix C). The rubrics were designed, using a four-point scale, to measure the students' mastery of a given Program Learning Outcome. They were then built into the LiveText assignment. Thus, all student SA submissions were evaluated using an identical rubric (BUAO, 2016).

Learning Management System (LMS) Platform Reports

The LMS used to deploy online courses at the university was Blackboard. Blackboard is an online tool that allows instructors to provide class lectures, instructional resources, and student assessments online via their templated platform (Blackboard, 2019). Blackboard offered robust reporting options for analyzing student activity within a course. This system tracked student activity within collaborative tools and time spent inside course content areas. Research Question 2 examined differences in student engagement in collaborative course activities. The following Blackboard LMS reports were used to measure engagement utilizing student data per course section.

- Course Activity Overview: This report displayed overall activity within a single course, sorted by student and date (Blackboard, 2019). Data produced via this report provided the time students spent logged into the course and measured participation in terms of attendance or time spent both actively and passively engaged in the course.
- Single Course User Participation: This report displayed the number of user submissions within discussions, blogs, and journals (Blackboard, 2019). Data produced via this report provided the number of times students actively engaged in these collaborated activities in the course.

Student Opinion Survey (SOS)

The university's Office of Academic Affairs developed a Student Opinion Survey (SOS), which was electronically deployed to all students in the second to last week of the term (BUAO, 2014). The SOS was an existing survey used by the university's Assessment Office to determine to what degree students were satisfied with the course they completed (BUAO, 2014). The SOS consisted of 36 questions that measured student perceptions pertaining to experience interacting with the instructor and the learning environment, feelings about the learning experience, impressions of the instructor, experience pertaining to the structure of the curriculum, and experience pertaining to the technology used in the course (BUAO, 2016).

The survey consisted of 36 questions that required students to assess their experience using a Likert scale consisting of the items strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. The survey closed with two open-ended questions that asked students to share additional information if desired. A copy of the survey can be found in Appendix D.

The SOS data was extracted only from the questions pertaining to student experiences with the structure of the curriculum. These questions included the following: This course…

Q 19. Met the stated learning objects and goals.

Q 20. Gave opportunities to demonstrate understanding throughout the class.

Q 21. Provided opportunities for quality online interactions.

Q 22. Offered online collaborative work that helped meet course objectives.

Q 23. Offered outside independent work that facilitated learning and met course objectives.

Q 24. Provided content/materials that facilitated learning and met course objectives.

Q 25. Provided readings that facilitated learning and met course objectives.

Q 26. Provided assignments that facilitated learning and met course objectives.

Q 27. Provided assessments/tests/exams that aligned with course objectives.

This data was collected from students who completed the interactive multimedia-based version of the online course, and was compared to the SOS data from students who completed the text-based version of the online course and used to address Research Questions 3 as it pertained to the differences in student satisfaction. The goal was to determine if students who completed the interactive multimedia-based course had a higher mean satisfaction rating on specific questions related to the course design than those who completed the text-based version.

Instrumental Validity and Reliability

Validity in quantitative data was determined by the instrument's ability to measure the desired data (Patton, 2015). McMillan and Schumacher (2010) stated a benefit to using historical data was higher data quality (p. 243). Additionally, they shared that the findings that result from secondary analysis "have a high degree of validity and reliability" (p. 243).

The Learning Management System and Significant Assessment Databases used for this study were widely used among higher education institutions, and their reporting systems are widely regarded as reputable among accreditation bodies (Blackboard, 2019; Livetext, 2016; Turnitin, 2019). The Student Opinion Survey was developed by the university's Office of Academic Affairs, approved by the Faculty Executive Council, and deployed in every course throughout the university as the primary method of collecting student feedback (BUOA, 2016). These tools have been used by the university to collect and analyze data for generating WASC, CCNE, and other accreditation body reports.

Data Collection

In causal-comparative design, researchers often collect and analyze secondary data from both groups and compare the data to determine the differences as they pertain to the dependent variables (McMillan & Schumacher, 2010, p 240). Historical data is data that has already been collected (p. 242). Per McMillan and Schumacher (2010), this method of data collection was faster and less expensive, but also often resulted in better quality and larger datasets.

In this study, secondary data on student performance, engagement, and satisfaction was extracted from existing databases. Student performance data was extracted from the Significant Assessment (SA) database, student engagement data was extracted from the Learning Management System (LMS) and student satisfaction data was extracted from the existing Student Opinion Survey (SOS) response database.

Once the course samples were identified and university approval was obtained, the researcher began the data collection process. Reports were pulled from each of the instruments and then organized into data tables using Microsoft Excel. These data tables are located in Appendices D, E, & F.

Student performance data was collected from the Significant Assessment (SA) database. Student and instructor identifiers were removed. The researcher created a Student Performance table to collect and organize student performance data for each course (Appendix E). The table contained the individual student scores per course pertaining to Significant Assessment. This data was then tabulated for each course pair.

Student engagement data was collected from each course using the activity tracking reports available within the LMS. Student and instructor identifiers were removed. The researcher created a Student Engagement table to collect and organize student engagement data (Appendix F). The table contained the individual student activity data per course as they pertained to time spent and active submissions in the discussion, journal and wiki tools deployed in each course. This data was then tabulated by data type, time and submissions, for each course pair.

Student responses to questions 19 to 27 on the Student Opinion Survey (SOS) pertaining to course curriculum design were also collected. This data was expressed numerically using a Likert rating scale, and a per-class report was pulled showing individual student satisfaction rates per question. Instructor and student information was removed from the report along with the unused questions. The researcher created a Student Satisfaction table to collect and organize student satisfaction data (Appendix G). The table contained the mean SOS scores for questions 19 to 27, per student, as expressed on a Likert scale. This data was then tabulated for each course pair.

Data Analysis

Data collected from both versions of the courses were analyzed for variance via a two-sample z-test with independent groups using MegaStat for Microsoft Excel 2010, a statistical software program. The goal of this analysis was to determine if a difference existed between the data collected from the interactive multimedia-based version of the course pair and the data collected from the text-based version of the pair as it pertains to student engagement, performance, and satisfaction. A summary of the data analysis by research question is included in Table 9 and detailed further below.

Table 9

Data Analysis Methods by Research Question

Research Question	Data Analysis
1. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?	Inferential statistics. Two-sample Z-Test independent groups.
2. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?	Inferential statistics. Two-sample Z-Test independent groups.
3. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?	Inferential statistics. Two-sample Z-Test independent groups.

The first research question asked: what is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education? This question was answered using inferential statistics. The MegaStat Microsoft Excel add-in was used to determine whether there is a difference in the significant assessment mean scores of the students who completed the interactive multimedia-based online course versions and students who completed the text-based online course versions. Data was analyzed using a two-sample z-test with independent groups. A z-test was chosen because the sample totaled more than 30 courses and the objective was to determine if there is a difference between the means of both groups (McMillan & Schumacher, 2010, p. 299).

The second research question asked: what is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education? This question was also answered using inferential statistics. To determine whether there were differences in the engagement levels between students who completed interactive multimedia-based online course versions and students who completed the text-based online course versions, activity levels within each tool were generated from the LMS and the data was analyzed using the two-sample *z*-test with independent groups. A *z*-test was chosen because the sample totals more than 30 courses and the objective was to determine if there is a difference between the means of both groups (McMillan & Schumacher, 2010, p. 299). This test allowed the researcher to analyze the specific differences pertaining to student engagement (McMillan & Schumacher, 2010, p. 301).

The third research question asked: what is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education? This question was also answered using inferential statistics. A two-sample z-test with independent groups was chosen because the sample totaled more than 30 courses and the objective was to determine if there was a difference between the means of both groups (McMillan & Schumacher, 2010, p. 299). This test allowed the researcher to analyze the specific differences pertaining to student satisfaction (McMillan & Schumacher, 2010, p. 301). This test was appropriate because the purpose of the test was to determine if there is a statistical difference between two groups (McMillan & Schumacher, 2010, p. 301).

Limitations

While this study did address the under-researched area of interactive multimedia-based online higher education course design, several limitations existed.

1. The sample population was not random. The study was limited to one university. Other universities' approaches to online interactive multimedia-based instructional design were not considered. Thus, the internal validity of the research could be threatened (McMillan & Schumacher, 2010).
2. The research scope was further limited to the programs and courses selected due to the university's course development and revision pipeline schedule as well as availability of interactive multimedia-based courses that met the study's criteria.
3. Due to the study design, the data collected from the sample population was compared to data collected from a different sample population. While these two-samples were different, since they are pulled from the same overall population, one could conclude that the environmental factors affecting Sample 1 also proportionately affected Sample 2. There was also no control group to determine cause and effect.
4. Lastly, due to the nature of the ex-post facto research design, the data collected to analyze student satisfaction and student performance was limited to the existing data collection tools and could not be customized by the researcher for this study.
    a. Signature Assignment Rubric Template (Appendix C) – For the purpose of this study, student performance was measured using mean scores for student performance on significant assessments. The university uses a four-point grading rubric, which measures student mastery of given assignment criteria as it pertains to the program and institutional learning outcomes. The assessment databased, used to house these rubrics for grading, does not allow for scaling or point ranges. This limits the variation of grading between the 4, 3, 2, 1 scale and thus limits the variation in performance data.

b. Student Opinion Survey (Appendix D) – The survey had been developed during the 2008/2009 academic year by the Faculty Personnel Committee (FPC), without the intent of collecting data related to the scope of this study. However, the student satisfaction survey data related to course design, allowed the researcher to extrapolate meaning to satisfy research question 3. Given the opportunity to design a survey measuring the impact of interactive, multimedia-based online instruction on student satisfaction, more specific questions would have been asked. Thus, the findings of this study, related to student satisfaction, were limited to the scope of the existing survey (Appendix D).

Additional concerns related to the researcher's close ties to the study were mediated to maintain neutrality and increase credibility. The researcher held a leadership role within the instructional design department at the university and co-authored the manual for implementing IMBID in online course design. As a result, the following procedural steps were taken to address researcher bias.

1. The researcher utilized an ex post facto research design that allowed for only existing data to be analyzed (McMillan & Schumacher, 2010, p 224).
2. The researcher was also removed from the data-collection process. Data was collected via automated system administrative reports and provided for analysis.
3. During the analysis phase, a second coder analyzed the data and the results were compared to the researcher's analysis to ensure intercoder consistency (Patten, 2012, p 683).

Summary

Chapter III discussed the population and sample population as it relates to the study design, purpose, and research questions. Description of the data-collection instruments and processes was provided. Finally, the method of data analysis and study limitations were reviewed. The following chapters examine the study results, applicability, and recommendation for further research.

CHAPTER IV: RESEARCH, DATA COLLECTION, AND FINDINGS

Overview

This quantitative causal-comparative single-case study used a nonprobability sampling to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education. This chapter provides a review of the research's purpose, questions, and design. The study's population and sample population are discussed. Additionally, research methods, data collection procedures, and instrumentation are explained. The chapter continues by applying an analysis of archival data obtained for the research to answer the study's questions. It concludes with a brief summary.

Purpose Statement

The purpose of this quantitative causal-comparative single case study was to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education

Research Questions

The following research questions will be used to guide the purpose of this study:

1. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?
2. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of

student engagement in higher education?

3. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?

Research Methods and Data - Collection Procedures

The study addressed the research questions using a quantitative causal-comparative, also known as ex post facto, research design. The research was conducted using archival data related to student performance, engagement, and satisfaction from text-based online courses and interactive, multimedia-based online courses. The main goal of the study was to determine if there is a difference between the student data from each of the instructional modalities.

Instrumentation

This causal-comparative study utilized databases employed by the university which housed the archival student performance, engagement, and satisfaction data. This data was collected using historical reports, which are used to provide records of past events (McMillan & Schumacher, 2010). Student performance data was collected using two Significant Assessment (SA) databases. Student engagement data was collected using reports produced by the Learning Management System (LMS). Student satisfaction data was collected from past Student Opinion Surveys (SOS) deployed regularly by the university (Appendix D). From these systems, reports were generated to collect student data related to student performance, engagement, and satisfaction from both the text-based and interactive multimedia-based versions of the course-pairs.

Significant Assessments/Performance. Courses selected for this study contained a Significant Assessment (SA). The SAs were aligned to a given Program Learning Outcome (PLO) and measured student mastery of the course and program objectives. The university utilized two SA databases to house, assess and track student performance on SAs. These databases, LiveText and Turnitin, offered a report that produced student scores on a given SA for a course offering by term. This data was collected, tabulated, and analyzed to address Research Question 1 as it pertained to student performance.

Turnitin. Students submitted assignments via Turnitin, providing users with plagiarism detection and an ability to grade the assignment using a built-in rubric (Turnitin, 2019). For this study, Turnitin was used as a plugin within the Learning Management System (LMS), Blackboard. Students submitted papers via Turnitin, which were then evaluated using a pre-built rubric, thus ensuring all student submissions were evaluated using an identical rubric (BUAO, 2016).

LiveText. Courses examined in this study that were offered through the Education collected SA data via LiveText (BUAO, 2016). Like Turnitin, students submitted papers via LiveText, which were then evaluated using a pre-built rubric. This allowed student SA submissions to be evaluated using an identical rubric (BUAO, 2016).

Learning Management System/Student Engagement. The university utilized the Blackboard LMS to deploy online courses. In addition to allowing instructors to provide class lectures, instructional resources, and student assessments online, Blackboard offered robust reporting options for analyzing student activity within an online course. The system tracked student activity in collaborative tools within a course and overall time individual students spent within the course. The Course Activity Overview and Single Course User Participation reports provided by the Blackboard LMS were used to collect student engagement data. This data was then tabulated and analyzed to address Research Question 2 pertaining to student engagement.

Course Activity Overview. This report displayed overall activity within a single course, sorted by student and date (Blackboard, 2019). Data produced via this report provided the time students spent logged into the course and measured participation in terms of attendance or time spent both actively and passively engaged in the course.

Single Course User Participation. This report displayed the number of user submissions within discussions, blogs, and journals (Blackboard, 2019). Data produced via this report provided the number of times students actively engaged in these collaborative activities in the course.

Student Opinion Survey/Satisfaction. The university's Office of Academic Affairs developed a Student Opinion Survey (SOS) (Appendix E), which was electronically deployed to all students in the second-to-last week of the term (BUAO, 2014). The web-based survey, administered through Blackboard Enterprise Surveys, consisted of 36 questions that required students to assess their experience using a Likert scale with items including strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. The student opinion data was extracted from questions 19 to 27 online. These questions pertained to student experiences with the structure of the online curriculum. This data was collected from students who completed the interactive multimedia-based version of the online course and those that completed the text-based version of the online course. The data was tabulated and analyzed to address Research Question 3 pertaining to student satisfaction.

Data-Collection Procedures

Gay and Airasian's (2003) sample size table was used to determine the required number of participants comprising the students enrolled in text-based courses and those enrolled in interactive multimedia-based courses. With a population of 9,000,000 representing the number of students enrolled in online courses to obtain a 95% confidence level and statistically significance of $p \leq 0.05$, a sample size of at least 384 was required (Gay and Airasian, 2003, p 113). Efforts to minimize error variance resulted in the following standardized data-collection procedures and process (DeVellis, 2012; McMillan & Schumacher, 2010):

Sampling Frame Selection. The university selected for this study was ideal because it offered a large number of online courses across a variety of disciplines. The university also utilized a course-master-copy-out model whereby courses were designed by content experts in partnership with instructional designers, built out within the Blackboard Learning Management System (LMS) as course masters, then copied into live sections for faculty to instruct from. This model provides a level of course consistency across sections required for a study of this nature and size. Lastly, within the last three years, this university revised multiple courses, originally designed to be text-based, to become interactive and multimedia-based. These unique aspects allowed the researcher to compare students who completed the text-based version of a course to those who completed the interactive multimedia-based version of the same course. It also ensured a significantly larger sample size than has been achieved thus far for a study of this nature.

Multi-Tiered Data Collection. Considering the population of online students to be 9 million students, the researcher employed a multi-tiered sampling method to identify the survey sample. Using nonprobability purposeful convenience sampling, the researcher identified the sampling frame of 7,812 students enrolled in online courses at the university. Then the researcher used nonprobability purposeful sampling to identify the survey population of 1,570 students who completed either text-based or interactive multimedia-based versions of courses. From there, both proportional stratified random sampling and nonprobability purposeful sampling were employed to ensure the correct quantity of student data was collected and that the data represented was proportional to the sampling frame. This method, illustrated in Figure 8, resulted in survey sample data representing the level of student performance of 812 students, level of student engagement of 812 students, and level of student satisfaction of 580 students.

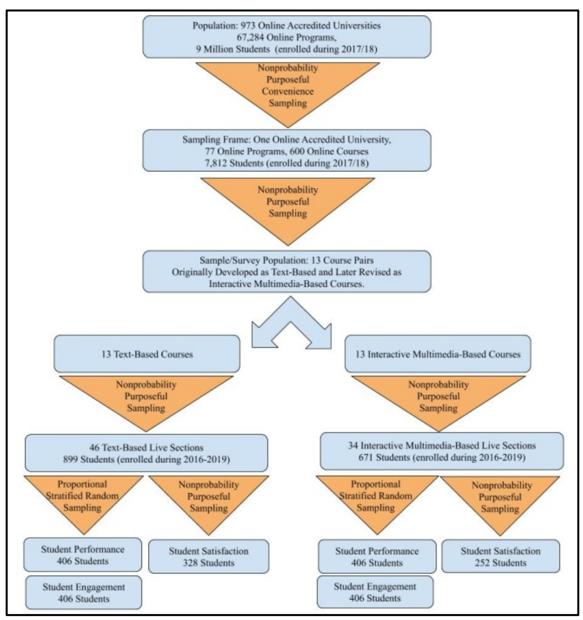


Figure 8. Multi-Tiered Sampling Approach

Archival Data Collection. Once the live sections of the courses were identified, administrative systems reports were generated to collect student data. Individual reports were provided related to student performance, engagement, and satisfaction. Student and instructor identifiers were removed from the data, prior to organization, to ensure anonymity and avoid bias.

Data Organization. The raw data was tabulated by course, combining like live sections of courses. The data was then sorted by text-based and interactive multimedia-based version. This allowed the researcher to later employ a proportional stratified random sampling of student performance and engagement data for analysis, further increasing the validity of the results.

Population

The Accredited Online Colleges (2018) database listed 973 online accredited universities and 67,284 fully online programs with over 9 million students across the United States. This represented the population for this study. The objective of this study was to determine if there is a difference between text-based online instruction and multimedia-based online instruction. A sampling frame is a subset of the population further identifying delimiting factors related to the actual study participants (McMillan & Schumacher, 2010). Therefore, the study's sampling frame included one online accredited university located in Southern California that offered the same online courses in both text-based form and interactive multimedia-based form. In ex post facto design, where archival data is used, the sample, or survey sample, are those from which the data is to be collected (McMillan & Schumacher, 2010). This study's sample included students enrolled in traditional text-based online courses and students enrolled in interactive multimedia-based online versions of the same courses.

Sampling Frame

The university which offered the sampling frame for this study offered 77 fully online degree-granting programs and over 600 fully online courses (Brandman, 2018). The student population size during the 2017-2018 academic year was reported to be 7,812 students (National Center for Education Statistics (NCES), 2018). Of this, 3,677 were undergraduates and 4,135 were graduate students (NCES, 2018).

Sample

Due to the organizational system for classes at the university where this research took place and qualifying factors related to the purpose of this study, random sampling of students was not possible. As a result, this study applied nonprobability, purposeful sampling to identify a survey population. This approach identified a series of 13 higher education course-pairs that were originally designed using a text-based model and later revised to become interactive and multimedia-based. The researcher reviewed the study's purpose, required data, research design, study qualifications, and archival data available to determine the best sample population to answer the three research questions (McMillan & Schumacher, 2010).

Demographic Data

To conduct this study, the researcher purposefully sampled 13 course-pairs using the study qualifiers detailed in Chapter III. Course qualifiers included courses that:

- ran fully online
- contained a significant assessment

- were originally designed as traditional text-based online courses and later redesigned to using an interactive multimedia-based approach.

Courses considered text-based consisted primarily of textbook and journal readings and written assignments. Courses considered to be interactive, multimedia-based courses applied the principles of connectivism, active learning theory, and multimodality theory through weekly, interactive, multimedia-based learning activities as detailed in Table 10.

Table 10

Multimodality Learning Theory Applied to Sampling Frame

Learning Activity	Description	Connective	Active	Multimodal
User Control	Students engage with multimedia content through user control functions that allow them to play, pause, stop, rewind, search, etc.	Student-to-Artifact	Reflection	VAR
View and Reflect	Students engage with media content and respond with a video or text reflection.			VAR
View and Discuss	Students engage with media content and engage in a group discussion either via video or via text.	Student-to-Human	Discussion	VAR
View and Present	Students engage with media content and create a visual presentation.			VAR
In Video Quizzing (IVQ)	Students answer questions embedded inside the media content they are engaging with. This is often linked to the grade book and student performance is tracked.	Student-to-Artifact	Application	VARK
Hotspot Media	Students mouse over or click on media content to learn more about the item.			VARK
Game-Based Learning (GBL)	Students participate in gameplay to achieve learning outcomes, thus winning the game.			VARK
Simulation	Students complete an artificial representation of a real-world process to achieve learning outcomes.			VARK
View and Do	Students engage with media content and replicate actions on their own as they are demonstrated for them.			VARK

Each interactive multimedia-based course consisted of multiple interactive multimedia-based learning activities, requiring students to actively engage with multimodal content consistently each week of the course. Table 11 provides a summary of the types and frequency of these activities organized by course.

Table 11

Sampling Frame IMBID Profiles Checklist

Courses	User Control	View and Reflect	View and Discuss	View and Present	IVC	Hotspot Media	GBL	Simulation	View and Do
Course 1		8	11	2				1	1
Course 2	11		9					8	7
Course 3		5	8	2		1	2	1	8
Course 4	14		8	1					5
Course 5	12	8	1			3	8	3	
Course 6	23		8	2				8	8
Course 7	8	4	7	1		2		4	
Course 8	8		8	2	14	3			8
Course 9	7		10	1			1	1	3
Course 10	3		8	1					4
Course 11	4	2	9	3			1	1	
Course 12	8	4	8	5			8	2	2
Course 13		6	2	2			8	2	3

Note: IVC=In Video Quizzing, GBL=Game-Based Learning.

Of the 13 course-pairs selected for the study, 5 course-pairs were from the School of Education and 8 were from the School of Arts and Sciences. In terms of degree level, five course-pairs were bachelor-level and eight course-pairs were master-level. Each course-pair included the same course offered in two modalities, text-based and interactive multimedia-based, resulting in 26 courses in total. From these, the researcher identified 80 sections that had been taught between 2015 and 2019 for which archival data was available. This included 46 text-based sections and 34 interactive multimedia-based sections. Based on course enrollments, this resulted in a nonprobability, purposeful sampling of 1570 students (Appendix B).

To increase validity, zero values were removed from all data sets. Student performance and engagement data from each section was randomly selected proportionately from each course section to total 35 student samples per course. In course pairings where one of the course modalities did not contain 35 students, the researcher selected the maximum number of student data samples available. This proportional stratified sampling ensured that each course section had equal representation of student data.

This approach resulted in 812 students from which archival data was collected. This data represented the level of student performance and engagement from 406 students who completed the text-based versions and 406 students who completed the interactive multimedia-based versions. Table 12 illustrates the results of this data-selection process.

Table 12

Student Performance and Engagement Survey Sample Data Size

	Text-Based Sample N=	IMBID Sample N=
Course 1	35	35
Course 2	35	35
Course 3	35	35
Course 4	22	22
Course 5	35	35
Course 6	35	35
Course 7	35	35
Course 8	16	16
Course 9	33	33
Course 10	20	20
Course 11	35	35
Course 12	35	35
Course 13	35	35
Total	406	406

The availability of student opinion data was significantly lower than that of student performance and engagement data due to student opinion survey completion rates. As a result, the researcher used all of the available student opinion data representing the level of student satisfaction, as it pertains to the design, from 328 students who completed text-based versions and 252 students who completed interactive-multimedia-based. In total, of the 1,570 students who completed the live sections of the original 13 course pairings, student satisfaction data was collected and from 580 students. Table 13 presents the results of this data selection process and Appendix B lists the number of student satisfaction samples collected per course section.

Table 13

Student Satisfaction Survey Sample Data Size

	Text-Based Data N=	IMBID Data N=
Course 1	14	18
Course 2	32	35
Course 3	36	29
Course 4	20	7
Course 5	14	30
Course 6	26	14
Course 7	21	15
Course 8	37	4
Course 9	24	9
Course 10	34	10
Course 11	27	23
Course 13	21	31
Course 14	22	27
Total	328	252

Presentations and Analysis of Data

The following section begins with a discussion on the type of statistics used to analyze the data collected from the learning management reports. The research questions and hypothesis are then presented. This is followed by an analysis of the data in relation to each research question.

Statistical Processes Utilized for Data Analysis

The three research questions were evaluated for causal-comparative analysis to determine if there was a difference between online text-based instruction and online interactive multimedia-based instruction as it relates to student performance, engagement, and satisfaction. A non-equivalent group design was used to compare historical student data from those who completed the text-based version of the course to those who completed the interactive multimedia-based version of the course. System Administration reports were pulled from the Learning Management System, Significant Assessment Databases and the Student Opinion Survey database, and student data from the 13 course-pairs was extracted.

The data was tabulated for each course pair, organized by type, performance (Appendix E), engagement (Appendix F), and satisfaction (Appendix G), and separated by modality, text-based versus interactive multimedia-based instruction. Appropriate statistical procedures were selected and used in the study (McMillan & Schumacher, 2010). The data analysis was completed using the statistical software MegaStat for Microsoft Excel 2010. The independent variables were the two course modalities, text-based and interactive multimedia-based courses. The dependent variables were student performance, engagement, and satisfaction.

Student performance, engagement, and satisfaction data was analyzed using Megastat with a 95% confidence level ($p= .05$) to determine statistical significance. Inferential statistics was used to determine the existence of a statistical difference between the two groups (Patten, 2012). The independent two-sample *z*-test compared the means from each course pair as they pertained to the levels of student performance, engagement, and satisfaction. An independent sample *z*-test is used to determine statistical difference when comparing the means of two independent groups with samples greater than 30 (McMillan & Schumacher, 2010). A second researcher analyzed the data using Megastat to ensure consistency (Patten, 2012, p 683). A summary of these procedures is provided in Table 14.

Table 14

Research Design Alignment Table

Research Question	Instrumentation & Collection	N=	Analytical Technique
Research Question 1 What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?	Signature Assignment Database (Turnitin & LiveText) • Signature Assignment report provided student scores on Significant Assessments (Signature Assignments) which measured the students' mastery of a given Program Learning Outcome (PLO).	812 (Appendix E)	Data tabulated. Two-sample *z*-test with independent groups conducted. Inferential statistics to determine the existence of a statistical difference.
Research Question 2 What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?	Learning Management System (LMS) (Blackboard) • Single Course User report provided the number of student submissions to collaborative tools (wikis, journals, blogs, discussion forums, etc). • Course Activity Overview report provided the length of time the student spent in the course for the duration of the 8-week term.	812 (Appendix F)	Data tabulated. Two-sample *z*-test with independent groups conducted. Inferential statistics to determine the existence of a statistical difference.
Research Question 3 What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?	Student Opinion Survey (SOS) • SOS report provided data extracted from student responses to questions 19-27 (Appendix D) pertaining to the level of student satisfaction with the design of the course.	580 (Appendix G)	Two-sample *z*-test with independent groups conducted. Inferential statistics to determine the existence of a statistical difference.

Inferential Statistics

Inferential statistical tests are used to identify if a relationship or difference between variables is statistically significant (McMillan & Schumacher, 2010). Statistical significance helps the researcher to rule out one important threat to validity, and that is that the result could be due to chance rather than to real differences in the population (Patten, 2012). This study seeks to identify whether differences exist between text-based instruction and interactive, multimedia-based instruction as it relates to the level of student performance, engagement, and satisfaction in online courses. The research questions required inferential statistics to determine if there was a difference in the levels of student performance, engagement, and satisfaction between students who completed the text-based versions and those who complete the interactive, multimedia-based versions of online courses.

Data Analysis

The following is a summation of the data analysis, presented in order of question.

Research Question 1: Student Performance. This question asked: What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?

To address this question, a two-sample z-test with independent groups with known variances was used. Significant differences between students who completed text-based courses and students who completed interactive, multimedia-based courses were found. Table 15 examines where there is a difference between the two groups in terms of student performance on significant assessments. The mean performance levels of students completing text-based courses (91.03) and students completing online interactive, multimedia-based courses (95.49) were found to be statistically different ($z = -7.44$, $p < .05$).

Table 15

Student Scores on Significant Assessments (SA) Analysis Per Course

	Text-Based SA GRADE	IMBID SA GRADE
Mean	91.0329	95.4854
Standard Deviation	10.5183	5.8943
Known Variance	110.6341	34.7434
Observations	406	406
Hypothesized Mean Difference	0	
Difference	-4.4525	
Standard error of difference	0.59839	
z	-7.44	
P(Z<=z) two-tail	1.0014E-14	
z Critical two-tail	1.96	

$p < .05$

Research Question 2 Student Engagement. This question asked: What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?

For the purpose of this study, engagement was analyzed using the number of times a student submitted to a collaborative course tool and the length of time a student spent in the course. Thus, two analyses were done. The first determined if there was a difference in the number of student submissions to collaborative tools between the two instructional modalities. The second determined if there was a difference in the amount of time students spent in the course between the two instructional modalities.

To address this question, a two-sample *z*-test with independent groups with known variances was used. Significant differences between students who completed text-based courses and students who completed interactive, multimedia-based courses were found. Table 16 examines the differences between the two groups as it relates to engagement in terms of the number of student submissions. Table 17 examines the differences between the two groups as it relates to engagement in terms of the amount of time students spent in the course. The mean number of student submissions to collaborative tools for students completing text-based courses (32.50) and students completing interactive, multimedia-based courses (38.74) were statistically different ($z = -10.33$, $p < .05$). Additionally, the mean amount of time students spent in the text-based courses (35.42 hours) and students completing online interactive, multimedia-based courses (157.14 hours) was statistically different ($z = -17.67$, $p < .05$).

Table 16

Student Submissions to Collaborative Course Tools Analysis Per Course

	Text-Based Submissions	IMBID Submissions
Mean	32.50	38.74
Standard Deviation	7.67	9.45
Observations	406	406
Hypothesized Mean Difference	0	
Difference	-6.236	
Standard error of difference	0.604	
Z	-10.33	
P(Z<=z) two-tail	0	
z Critical two-tail	1.96	

$p < .05$

Table 17

Student Time Spent in Course Analysis Per Course

	Text-Based Total Time Spent	IMBID Total Time Spent
Mean	35.4170	157.1370
Standard Deviation	26.6250	136.6330
Observations	406	406
Hypothesized Mean Difference	0	
Difference	-121.72	
Standard error of difference	6.89	
Z	-17.67	
P(Z<=z) two-tail	0	
z Critical two-tail	1.96	

$p < .05$

Research Question 3: Student Satisfaction. Research Question 3 asked: What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?

To address this question, a two-sample z-test with independent groups with known variances was used. Significant differences between students who completed text-based courses and students who completed interactive, multimedia-based courses were found. Table 18 examines the differences between the two groups in terms of student satisfaction related to the design of the course. The mean student satisfaction levels related to the design of the course of students completing text-based courses (4.27) and students completing online interactive, multimedia-based courses (4.58) were statistically different ($z = -5.07$, $p < .05$).

Table 18

Student Opinion Survey (SOS) Satisfaction Analysis Per Course

	Text-Based SOS	IMBID SOS
Mean	4.2705	4.5765
Standard Deviation	0.8373	0.6144
Observations	328	252
Hypothesized Mean Difference	0	
Difference	-0.306	
Standard Error of Difference	0.0603	
Z	-5.0736	
P(Z<=z) two-tail	3.9046E-08	
z Critical two-tail	1.96	

$p < 0.05$

Summary

This chapter presented the statistical results of a single-case study conducted at an accredited online California university. The purpose of this quantitative causal-comparative study was to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in online higher education courses. The demographics of the courses sampled were reviewed and the data collected was representative of the overall population. The data was analyzed using a two-sample *z*-test with independent groups.

The findings from this study (Table 19) pointed to a statistical difference between the levels of student performance, engagement, and satisfaction between students who completed text-based versions online courses and those who complete interactive, multimedia-based versions of online classes. While statistical differences were observed in all of the independent variables, the greatest impact was on student engagement in terms of time spent in the course (*z*-score= -17.67) and the number of student submissions within collaborative course tools (*z*-score= -10.33), followed by student performance (*z*-score= -7.44), and then student satisfaction (*z*-score= -5.07).

Table 19

Student Scores on Significant Assessments (SA) Analysis Per Course

	N=	Text-Based Design	N=	Interactive Multimedia-Based Design	z
Performance	406	91.0329	406	95.4854	-7.44
Engagement (Submissions)	406	32.50	406	38.74	-10.33
Engagement (Time)	406	24.625	406	136.633	-17.67
Satisfaction	328	4.2705	252	4.5765	-5.07

$p < .05$

CHAPTER V: FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter begins with a restatement of the study's purpose and research questions. This is then followed by a summary of the methodology, population, and sample population. Major findings from the study are presented, followed by unexpected findings. Implications derived from the study and recommendations in terms of researchers, practitioners, and policymakers are then provided. The chapter closes with a reflection by the researcher on personal insights and impacts related to the study.

Purpose Statement

The purpose of this quantitative causal-comparative single-case study is to determine if there is a difference between interactive, multimedia-based online instruction and traditional text-based online instruction as it relates to the level of student performance, engagement, and satisfaction in higher education.

Research Questions

The following research questions will be used to guide the purpose of this study:

1. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student performance in higher education?
2. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student engagement in higher education?
3. What is the difference between interactive, multimedia-based online instruction and text-based online instruction as it relates to the level of student satisfaction in higher education?

Research Design

This quantitative single-case study utilized a causal-comparative, also referred to as ex post facto, research design to investigate the relationship between text-based online instruction and interactive, multimedia-based online instruction as it relates to student performance, engagement, and satisfaction. It used nonprobability, convenient, purposeful sampling to identify a university where traditional text-based courses had been redesigned using an interactive, multimedia-based instructional design approach. The researcher used nonprobability purposeful sampling to identify 13 course-pairs from which archival student data, related to student performance (n=812), engagement (n=812), and satisfaction (n=580), was collected (Table 14 in Chapter IV). The data was collected via administrative learning management system reports. The data was then tabulated and analyzed using two-sample *z*-tests with independent groups. Inferential statistics were used to determine the existence of a statistical difference.

Population

The Accredited Online Colleges (2018) database listed 973 online accredited universities and 67,284 fully online programs with over 9 million students across the United States. This represented the population for this study. A sampling frame is a subset of the population further identifying delimiting factors related to the actual study participants (McMillan & Schumacher, 2010).

Sampling Frame

The student population size at the university selected for this study during the 2017-2018 academic year was reported to be 7,812 students (National Center for Education Statistics (NCES), 2018). Of this, 3,677 were undergraduates and 4,135 were graduate students (NCES, 2018). The university offered 77 fully online degree-granting programs and over 600 fully online courses (Brandman, 2018).

Sample

This study applied a nonprobability, purposeful sampling approach to identify 13 course-pairs that had originally been developed using a text-based approach and were later redesigned to become interactive and multimedia-based. The researcher identified 80 sections of these courses that were offered between 2015 and 2017 and completed by 1,570 students. Of this group, 899 students completed the text-based version of the courses and 671 completed the interactive, multimedia-based version. Archival student data related to performance, engagement, and satisfaction was collected from each section. The researcher then applied proportional stratified random sampling to identify 406 students from each course modality, totaling 812 students, to collect student performance and engagement data from. Due to the response rate for student satisfaction surveys, the researcher selected all student satisfaction data, totaling 580 students, to use for the study.

Major Findings

The study was designed to identify if a difference existed in online higher education between text-based instruction and interactive, multimedia-based instruction in terms of the level of student performance, engagement, and satisfaction. The researcher identified four major findings and two additional unexpected major findings. The findings may be placed into one of three categories: student performance, engagement, or satisfaction. The major findings are organized by research question, followed by unexpected findings.

Major Finding 1: Student Performance

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design scored 5% higher on significant assessments than students who completed online courses designed to be primarily text-based. The data analysis found an average variance of 4.46 points between students who completed interactive, multimedia-based online courses and those who completed the text-based version of the course. The p-value of 1.0014E-14 was $\leq .05$, indicating a significant difference between the two means.

The critical z-value for $p \leq .05$ was 1.96 with the z-score for this analysis calculating to 7.44. This z-score indicates the number of standard deviations for the level of student performance in interactive, multimedia-based courses from the expected student performance or those enrolled in the text-based version of the course (McMillan & Schumacher, 2010). This suggests that leveraging multimedia technology to employ multimodal instruction and requiring students to interact with this media significantly impacted student performance. This is in alignment with research that suggested a correlation between interactive, multimedia-based instruction and student performance (Chen, Hung, & Kinshuk, 2012; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Peterson-Ahmad, 2018; Sapiano et al., 2018; Wang et al., 2018; Wu, 2018; Vural, 2013, Zhang, 2005; Zhang et al., 2006).

The overall data analysis of student performance showed a strong variance between students who completed the text-based course and those who completed the interactive multimedia-based version of the course with strong statistical significance at the $p \leq 0.05$ level. This denoted that a difference would be true 95% of the time. In assessing this variance, students who completed interactive multimedia-based versions of online courses performed 5% higher on significant assessments than those who completed the text-based version of the course. Since significant assessments assess a student's ability to master program learning outcomes, this means students who completed interactive, multimedia-based courses had a stronger mastery of program objectives.

Major Finding 2: Student Engagement - Submissions

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design engaged 19% more with collaborative learning tools than students who completed online courses designed to be primarily text-based. The data analysis found that students who completed interactive, multimedia-based online courses submitted items to the collaborative course tools, on average, 6.24 more times than those who completed the text-based version of the course. The p-value of 0 is ≤ .05 indicated a significant difference between the two means.

The critical z-value for p≤.05 was 1.96 with the z-score for this analysis calculating to 10.33. This *z*-score indicates the number of standard deviations for the level of student submissions within collaborative tools for those completing interactive, multimedia-based courses from the expected student submissions for those enrolled in the text-based version of the course. These findings suggest that the course design does have an impact on student engagement in terms of the number of student submissions to collaborative tools.

The data analysis of student engagement with regard to the number of times students submitted to collaborative tools showed a strong variance between students who completed the text-based course and those who completed the interactive multimedia-based version of the course, with statistical significance of $p \leq 0.05$. This denoted that the difference would be true 95% of the time. In assessing this variance, students who completed interactive multimedia-based versions of online courses were actively engaged with classmates and instructors within collaborative course tools at a rate of 19% more than those who completed the text-based version of the course.

Major Finding 3: Student Engagement - Time

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design spent 344% more time logged into the course than students who completed online courses designed to be primarily text-based. The data analysis found that students who completed interactive, multimedia-based online courses spent, on average, 121.72 more hours logged into the course than those who completed the text-based version of the course. The p-value of 0 is $\leq .05$ indicated a significant difference between the two means.

The critical *z*-value for $p \leq .05$ was 1.96, with the *z*-score for this analysis calculating to 17.67. This *z*-score indicates the number of standard deviations for the length of time students spent in interactive, multimedia-based courses from the expected length of time students spent in the text-based version of the course. This *z*-score suggests that the course design did have an impact on student engagement in terms of the length of time students spent in the course. This is in alignment with research that suggested a correlation between interactive, multimedia-based instruction and student engagement (Esteves et al., 2018; Parikh et al., 2011; Vural, 2013).

The overall data analysis of student engagement with regard to the time students spent logged into the course showed a significant variance between students who completed the text-based course and those who completed the interactive multimedia-based version of the course with strong statistical significance at the $p \leq 0.05$ level. This signified that a difference would be true 95% of the time. In assessing this variance, students who completed interactive multimedia-based courses spent, on average, 344% more time in the course than those who completed the text-based version of the course. As a result of this study, one can conclude that courses designed using IMBID increased students' level engagement with regard to the amount of time students spent engaging in the online learning environment.

Major Finding 4: Student Satisfaction

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design were 6% more satisfied with the design of the course than students who completed online courses designed to be primarily text-based. The data analysis found that students who completed interactive, multimedia-based online courses had a higher satisfaction rating, on average .31 points higher on a Likert scale of 1 to 5 than those who completed the text-based version of the course. The p-value of 0 is ≤ .05, indicating a significant difference between the two means.

The critical z-value for $p \leq .05$ was 1.96, with the z-score for this analysis calculating to 5.07. This z-score indicates the number of standard deviations for the level of student satisfaction related to course design in interactive, multimedia-based courses from the expected level for those enrolled in the text-based version of the course. This suggests that the course design does have an impact on student satisfaction. This is in alignment with the body of research that suggests a correlation between interactive, multimedia-based instruction and student satisfaction (Borup et al., 2013; Cherrett et al., 2009; Ching & Hsu, 2013; Henderson, 2016; Parikh et al., 2011; Wu, 2018; Zhang, 2005; Zhang et al., 2006).

The overall data analysis of student satisfaction, with regards to the design of the course, showed a strong variance between students who completed the text-based course and those who completed the interactive multimedia-based version of the course with strong statistical significance at the $p \leq 0.05$ level. This denoted that a difference would be true 95% of the time. In assessing this variance, students who completed interactive multimedia-based versions of online courses showed a higher rate of satisfaction related to course design that was 6% greater than those who completed the text-based version of the course.

Unexpected Findings

The data collected, sorted and analyzed for this study sought to determine if significant differences in levels of student performance, engagement, and satisfaction existed between online higher education courses designed using the principles of interactive, multimedia-based instructional design and those designed using primarily text-based instruction. The findings, as detailed above, detected significant differences amongst all three variables. Also, the study revealed two additional, unexpected findings, related to completion rates for significant assessments and student opinion surveys that were not part of the researcher's initial scope, but may point to further differences between the two instructional modalities.

Unexpected Finding 1: Student Performance

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design were 5% more likely to submit a significant assessment than students who completed online courses designed to be primarily text-based. During the data analysis process, the researcher removed all zero values from the student performance data and tabulated the zero counts per course (Table 8 in Chapter III; Appendix H). This was done to increase the validity of the data.

The original population of students completing text-based courses consisted of 899 students. Of this group, 67 zero values for student performance submissions were removed. This means text-based courses have a 92.5% completion rate on significant assessments. The original population of students completing the interactive multimedia-based courses consisted of 671 students. Of this group, 19 zero values for student performances submissions were removed. This means interactive, multimedia-based courses have a 97.2% completion rate on significant assignments.

This unexpected finding is noteworthy because researchers have tied attrition in online courses to both student failure rates and dropout rates (Heyman, 2010). Studies estimate that online courses have a 10% to 20% higher failure rate (Herbert, 2006) and a 40% to 80% higher dropout rate (Smith, 2010) than traditional ground-based classrooms. Students who neglected to submit these significant assessments may have done so for a variety of reasons, but this finding reveals that students who completed courses designed using the principles of IMBID were 5% more likely to submit significant assessments than those who completed primarily text-based courses.

Unexpected Finding 2: Student Satisfaction

Students who completed online higher education courses designed using the principles of interactive, multimedia-based design were 1% more likely to complete a Student Opinion Survey (SOS) than students who completed online courses designed to be primarily text-based. To determine if a difference existed with regard to the level of student satisfaction between students who completed text-based courses and those who completed interactive multimedia-based courses, the researcher collected data from Student Opinion Surveys (SOS). During the data collection process, it was revealed that the SOS completion rates were less than 50% per course (Appendix I).

The low completion rates affected the amount of data the researcher was able to collect in this area. This, in turn, affected the level of significance of the study. As a result, the researcher logged SOS completion rates to determine if there was a difference in SOS completion rates amongst students who completed the text-based version of the course and those who completed the interactive multimedia-based version of the course.

The original population of students completing text-based courses consisted of 899 students. Of this group, 328 students, or 36.5%, completed the SOS. The original population of students completing the interactive multimedia-based courses consisted of 671 students. Of this group, 252 students, or 37.6%, completed the SOS. Students who neglected to submit the SOS may have done so for a variety of reasons, but this finding revealed that students who completed courses designed using the principles of IMBID were 1% more likely to complete student opinion surveys than those who completed primarily text-based courses.

Conclusions

Based on the findings, it was concluded that students who completed online higher education courses designed using the principles of interactive multimedia-based design had significantly higher levels of student performance, engagement, and satisfaction, than those who completed text-based courses. Results from this study may assist practitioners in the field to better understand how students learn online, engage in online courses, and enjoy learning via the web, thus informing how educators design instruction and teach online.

Conclusion 1: How Students Learn Online

Interactive, Multimedia-Based Instructional Design (IMBID) positively impacts student performance. By making online learning multimodal and interactive, online courses designed using the fundamentals of IMBID help learners connect with content as well as demonstrate mastery. When applied to an entire course, IMBID leverages technology to apply multimodality learning theory, active learning theory, and connectivism to facilitate online instruction, learning activities, and assessments (Tables 2, 3 & 4 in Chapter IV). The result of this practice is student-centered, discussion, reflection and application style, multimedia-based, learning experiences that are more hands-on and multimodal, thus appealing to the Millennial learner while also deepening understanding.

Conclusion 2: How Students Engage in Online Courses

Interactive, Multimedia-Based Instructional Design (IMBID) positively impacts student engagement. By integrating both instructor and student videos, the level of perceived classroom presence increases (Hibbert, 2014; Koivula, 2018; Lazarevic, 2011).

Additionally, audio and video interaction help build connections with their peers in the online asynchronous classroom (Borup et al., 2013; Ching & Hsu, 2013). Incorporating this style of instruction and assessment consistently throughout the course design, while building interaction around these items, engages students more actively and more often. Lastly, because multimedia content is inherently multimodal, students of all learning style preferences feel more comfortable and confident engaging in the online classroom (Fleming, 2013). The result of building opportunities for classroom participants to consistently engage with each other and the instructor through the use of multimedia is a more communicative classroom environment.

Conclusion 3: What Students Enjoy About Online Course Design

Interactive, Multimedia-Based Instructional Design (IMBID) positively impacts student satisfaction. Courses designed using the principles of IMBID promote active, kinesthetic, and visual instruction, which appeals to the Millennial learner (Corich, 2008; Ke & Chavez, 2013). Additionally, the flexibility, personability, and access to asynchronous video found in courses designed using IMBID provide a face-to-face classroom experience at a time and location that is convenient for these on-the-go adult learners (Ke & Chavez, 2013). As a result, IMBID courses achieve higher levels of student satisfaction related to how well the course provides opportunities to demonstrate understanding, facilitate learning, engage in quality online interactions, work collaboratively and independently to meet the course objectives, and assess mastery of program learning outcomes.

Implications for Action

As detailed in the Literature Matrix (Appendix A), while studies of the impact of interactive, multimedia-based instruction in online courses have been conducted, to the researcher's knowledge, none have matched this study in size (N=812), structure (examining overall course design), and depth (spanning multiple content areas, covering data from three years of instruction, including data samples from 80 course sections, instructed by a wide range of full-time and adjunct faculty). Due to the unique nature of this study, the researcher was able to discover new information about how students learn, engage, and enjoy learning online. These results can be used by the e-learning industry to make decisions about online course design practices and policies as detailed in the IMBID Manual (Munro & Crowley, 2018) and outlined below.

Practice

Implication 1: Learners Are Not Created Equal. *Reach 100% of learners by instructing in all four modalities.* The VARK Institute identifies multimodality theory by four foundational sensory modalities—visual, aural, read/write, and kinesthetic—that they believe reflect the experiences of students and teachers (Fleming & Mills, 2018). In their 2017 study of over 45,000 college students, VARK reported learning preferences of university and college students as roughly equal amongst all modalities, concluding that, to reach 100% of students, one must instruct and assess through all four modalities (Table 1 in Chapter 1). Thus, online courses designed using the principles of IMBID must provide instruction and assess learning in all modalities. Additionally, this must be executed consistently throughout the course, via the use of high-quality, engaging, reputable, ADA-compliant media that is no longer than four minutes in length to ensure engagement (Table 2 in Chapter II).

Implication 2: Interaction Deepens Learning. *Engage students by making media interactive and identify opportunities for students to create their own media.* Online courses that apply active learning theory focus more on developing students' skills versus transmitting information (Brame, 2016; Cherret et al., 2009; Moreno & Mayer, 2007). Online courses employing active learning ask students to reflect, discuss or apply content learned (Cherret et al., 2009; Moreno & Mayer, 2007). In doing so, students cognitively engage and access higher-order thinking, which deepens learning (Brame, 2016; Cherret et al., 2009; Moreno & Mayer, 2007). Thus, online courses must require students to transform content into action by requiring students to interact with multimedia content as well as create their own multimedia content.

Implication 3: Connections Solidify Understanding. *Position media within the course by providing context and guidance for students.* Connected learning is grounded in the fundamentals of social learning theory, which states that people learn from one another. In the asynchronous online classroom, this extends beyond the human-to-human connection to include human-to-artifact (Zaker, 2013). Advancements in technology have changed how these connections occur online. They have also resulted in a plethora of information available on the web, which can often become overwhelming and in which meaning can become lost. Thus, online courses must explain why the content is important and provide contextualization for the content within the structure of the course learning objectives, assignments, and assessments.

Implications to Policy

Implication 4: Seat-Time Calculation Policy. *Implement policies for tracking seat-time based on the amount of time students spend logged into the Learning Management System (LMS).* Many online programs, where licensing is involved, are required to report seat-time for students. In traditional ground-based programs, this is calculated by the number of hours students spend in the classroom (Siemens, 2004). In online programs, seat-time is often estimated using a formula based on the expected completion time for each assignment. These estimates are often impossible to quantify for accreditation bodies and auditors as the majority of work in traditional online courses is done outside of the LMS. Courses designed using IMBID require students to actively engage with content within the LMS, thus increasing the time students spend logged into the course and allowing for real-time tracking of seat-time. The data collected from seat-time tracking policies can be used to both inform seat-time estimates and support these estimates for accreditation and licensure bodies.

Implication 5: Intergenerational Classroom Awareness Policy. *Implement policies requiring professional development to build awareness of generational learning needs.* To implement student-centered learning, online educators may first start with fully understanding their learners. Today's online classrooms can have as many as four generations of learners with unique attributes and needs. Building the generational intelligence of online educators will ensure they are aware of intergenerational differences and biases and that they are skilled at providing instruction that differs greatly from their own preferences. Lastly, an emphasis should be placed on looking forward to the needs of future generations of students and strategies for proactively enhancing course design to meet incoming generational learning style needs.

Implication 6: Learning Style Inclusion & Equity Policy. *Implement policies requiring online course design to be fully inclusive and equitable to all learning styles.* Current policies often address protected student classes based on race, ethnicity, and disability, but most online learning institutions have yet to implement policies related to learning styles and instructional modalities. This gap means online courses fail to meet the diverse learning styles amongst the Millennial and Generation Z students. Not only does this result in lower student performance, engagement, and satisfaction rates, it often disproportionately affects the self-efficacy and self-confidence of those who are aural, visual, and/or kinesthetic learners (Fleming, 2013). By implementing policies requiring multimodal instruction, e-learning institutions can ensure that online classrooms are inclusive and equitable for all styles of learners.

Implication 7: Data-Driven E-Learning Investment Policy. *Implement policies requiring proof of impact before investing funds into e-learning tools to ensure that money spent on technology yields student returns.* The acquisition of multimedia e-learning tools and the production of high-quality, interactive media content incur significant upfront costs. Findings from this study linked these investments to increased student retention through hard data, thus justifying the expense. Because no two technologies are the same, policies requiring piloting potential tools and tracking the impact on factors affecting retention will better inform university leaders about which technologies are likely to yield increased market share and sustainability.

Implication 8: Student Retention-Focused Policy. *Implement policies requiring all departments to focus on ways to address student retention.* Despite increasing enrollment rates in e-learning, online courses continue to show receding student retention rates far greater than those of traditional ground-based courses (Bawa, 2016). As the marketplace grows, so do concerns over student retention amongst online education leaders (Allen & Seaman, 2013). While this study focused on attrition linked to online course design, there are a variety of other variables impacting student attrition. University leaders who tackle these issues by finding causes and implementing policies to address them will likely see sustainable growth moving forward.

Contributions to Research

Existing research into online, interactive, multimedia-based instruction is limited in sample size, interactivity type, and level of implementation. As detailed in Tables 20 and 21, according to the researcher's knowledge, of these studies, only two examined data from more than 200 students, whereas this study examined data from 812 students. Most studies focus primarily on user control, whereas this study examined all types of IMBID activities. Each of the existing studies examined the impact of a single course activity designed to interactive, multimedia-based whereas this study examined the impact of entire courses designed to interactive, multimedia-based. While all studies aimed to measure the impact of interactive multimedia-based instruction on student engagement, performance, and/or satisfaction, no one study identified the effects on all three of these elements as this study did. Furthermore, due to the population size of 9 million online students, all existing research failed to achieve a sample size consistent with proving statistical significance. This study achieved $p \leq 0.05$ related to student performance, engagement, and student satisfaction. These levels allow the researcher to make predictions related to future outcomes with a 95% confidence level.

Table 20

Existing Studies Linking Interactive, Multimedia-Based Instruction to Increased Performance, Engagement, and Satisfaction

Researcher	N=	User Control	View & Reflect	View & Discuss	View & Present	IVC	Hot spot	GBL	Sim	View & Do	P	E	S
Borup et al., 2013	4	X		X									X
Chen, Hung, & Kinshuk, 2012	90	X		X		X	X				X		
Cherrett et al., 2009	75	X				X	X	X					X
Ching & Hsu, 2013	20	X		X						X			X
Delen, 2013	80	X				X	X				X		
Esteves et al., 2018	324	X				X	X	X			X	X	
Henderson, 2016	N/A	X	X								X		X
Kleinheksel, 2014	130	X	X						X		X		
Parikh et al., 2011	7		X									X	X
Peterson-Ahmad, 2018	8								X		X		
Sapiano et al., 2018	166								X		X		
Wang et al., 2018	90								X		X		
Wu, 2018	46								X		X		X
Vural, 2013	318	X				X				X	X	X	
Zhang, 2005	155	X									X		X
Zhang et al., 2006	138	X									X		X

Note: IVC=In Video Quizzing, GBL=Game-Based Learning, Sim=Simulation, P=Performance, E=Engagement, S= Satisfaction.

Table 21

The Current Study Linking Interactive, Multimedia-Based Instruction to Increased Performance, Engagement, and Satisfaction

Researcher	N=	User Control	View & Reflect	View & Discuss	View & Present	IVC	Hot spot	GBL	Sim	View & Do	P	E	S
Munro, 2019	812	X	X	X	X	X	X	X	X	X	X	X	X

Note: IVC=In Video Quizzing, GBL=Game-Based Learning, Sim=Simulation, P=Performance, E=Engagement, S= Satisfaction.

Recommendations for Further Research

Recommended Study 1: Further Scope to Examine Impact on Attrition. This study examined the impact of interactive, multimedia-based online instruction, as compared to text-based instruction, on student performance, engagement, and satisfaction. These variables were selected due to their connections to attrition, but the results from this study cannot be directly linked to increased student retention. Further examination of enrollment, degree completion, and attrition data for students from this study would effectively determine if course design directly impacts student attrition.

Recommended Study 2: Further Scope to Examine Variations Between On-Ground and Online Delivery. Literature suggests that online courses have a higher dropout and failure rating than ground-based courses (Accredited Online Colleges, 2018; Herbert, 2006; Heyman 2010; Smith, 2010). Furthermore, studies have linked student performance (Bawa, 2009; Jensen, 2010; Tyler-Smith, 2006), engagement (Bawa, 2009; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010), and satisfaction (Bawa, 2009; Herbert, 2006; Jensen, 2010) to student retention. This study examined the impact of interactive, multimedia-based online instruction, as compared to text-based instruction, on student performance, engagement, and satisfaction but it did not compare the findings to ground-based instruction. To further explore the impact of IMBID as a method of increasing student retention in higher education online courses, replication of this study could be conducted comparing the impact of interactive, multimedia-based online instruction, to ground-based instruction. Findings from such a study could be used to determine whether IMBID can be used to close the gap between online and ground-based instruction.

Recommended Study 3: Deepen Scope to Examine Variations. This study examined the impact of interactive, multimedia-based online instruction among multiple sections of courses taught by different faculty, in a variety of content areas, and at multiple degree levels. To further explore the impact of IMBID, replication of this study could be conducted to indicate whether a level of difference exists among these variables. Replication of this study could involve the following variations:

- Examining the impact of IMBID between course content types or academic programs.
- Examining the impact of IMBID between degree levels.
- Examining the impact of IMBID between individual instructors.

Recommended Study 4: Narrow Implications with a Control Group. This study examined the impact of interactive, multimedia-based online instruction among multiple sections of courses taught at the university but did not account for extenuating variables that could have also impacted student performance, engagement, and satisfaction. Further research, using a control group, would account for such variables and help narrow the understanding of the impacts resulting only from course design.

Recommended Study 5: Expand Scope to Other E-Learning Institutions. This study examined the impact of interactive, multimedia-based online instruction in higher education online courses but did not examine other types of online instruction outside of higher education. To further explore the impact of IMBID, replication of this study could be conducted to indicate whether similar patterns are identified in other types of e-learning such as professional development, MOOCs, Competency-Based Education, and/or K-12 Online.

Concluding Remarks and Reflections

The origin of distance education dates back to the 1700s, and though it has evolved drastically with technological advancements and learner needs, the heart of its purpose, to meet the learner where they are so that they may get to where they need to be, has remained constant. Though the student-centered model didn't appear in traditional classrooms until the 20th century, one could argue it is the essence of distance learning. As learner needs and technological advancements of future generations continue to shift, so must the ways that we leverage technology to provide high-quality, technology-rich, engaging, student-centered online instruction.

Today, e-learning is a $107 billion industry. The higher education sector accounts for over 9 million online students, with enrollment rates increasing rapidly. In addition to the affordability and convenience that make online courses attractive to students, similar attributes make this style of instruction appealing to universities. By significantly reducing school-operations costs, online universities have the potential of saving approximately $3,600 per student, a savings of more than a third over traditional ground-based programs (Battaglino, Halderman, & Laurans, 2012). Unfortunately, this savings does not guarantee high-quality course design, with many questioning their ability to meet the needs of all learners. This concern is supported by the fact that online courses are faced with significantly higher retention issues than their ground-based counterparts (Herbert, 2006; Smith, 2010). This is a reality that veteran e-learning institutions are highly aware of, with 44.6% of Chief Academic Officers acknowledging that retaining students is a more significant issue for online courses than ground-based courses and

67% considering online student retention a critical issue for the future of online education (Allen and Seaman, 2013).

These variations in attrition rates indicate that online courses, as they are typically designed, have a decreased ability to meet the needs of learners (Deborah, 2006; Hartsell & Yuen, 2006; Ke & Chavez, 2013; Krovitz, 2009; Michelich, 2002; Savery, 2005). Due to the hurried demand for web-based courses during the online education boom, at a time when e-learning tools and skillsets were limited, online courses were traditionally designed using text-based learning activities and assessments (Deborah, 2006; Hartsell & Yuen, 2006; Krovitz, 2009; Michelich, 2002; Savery, 2005). Today's online students are primarily Millennials, whose coming of age aligned with both the K-12 student-centered classroom movement and the rapid development in technologies focused on customization and personalization, such as high-speed internet, mobile devices, and artificial intelligence (Lazarevic, 2011; Redmond, 2017). These students identify their learning styles as active, kinesthetic, and visual and expect online courses to be designed to meet their individual needs (Corich, 2008). Instead, they are often faced with a single-modality course design that is often instructor- or content-centered (Ke & Chavez, 2013).

To sustain one's market share, organizations must address this disproportionate nature of attrition by identifying how students learn online as compared to on-ground. Research has shown a direct link between student performance, engagement, and satisfaction in online courses and student retention (Bawa, 2016; Herbert, 2006; Jensen, 2010; McMahon, 2013; Schaffhauser, 2009; Smith, 2010; Tyler-Smith, 2006). Furthermore, existing research (Table 20; Appendix A) into online course instruction reveals a positive relationship between interactive, multimedia-based instruction and student performance, engagement, and satisfaction (Borup et al., 2013; Chen, Hung, & Kinshuk, 2012; Cherrett et al., 2009; Ching & Hsu, 2013; Delen, 2013; Esteves et al., 2018; Henderson, 2016; Kleinheksel, 2014; Parikh et al., 2011; Peterson-Ahmad, 2018; Sapiano et al., 2018; Vural, 2013; Wang et al., 2018; Wu, 2018 Vural, 2013, Zhang, 2005; Zhang et al., 2006).

This study examined courses designed using the principles of Interactive Multimedia-Based Instructional Design (IMBID) which leverages multimedia-based technology to facilitate interactive, multimodal, connected learning within the online learning environment. In doing so, this study further supports existing research findings by adding that students who completed courses designed to be interactive and multimedia-based have higher levels of student performance, engagement, and satisfaction than those who completed traditional text-based online courses. Additionally, by selecting a sampling of courses, using the criteria outlined in Table 11 of Chapter IV, this study also provides insights into how learning takes place online. Lastly, implications from this study offer a structure for designing online courses, known as Interactive Multimedia-Based Instructional Design (IMBID), that best meets the needs of today's online learners, illustrated in Figure 9.

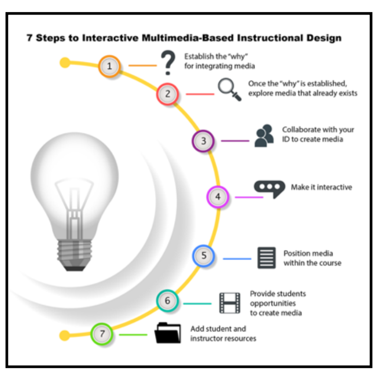


Figure 9. 7 Steps to Interactive Multimedia-Based Instructional Design (Munro & Crowley, 2018).

REFERENCES

Accredited Online Colleges. (2018). Guide to accredited online colleges and universities. Retrieved from https://www.accreditedonlinecolleges.org/

Allen, I. E., & Seaman, J. (2011). *Going the distance: Online education in the United States, 2011*. Newburyport, MA: Sloan Consortium.

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. Newburyport, MA: Sloan Consortium.

Allen, I. E., Seaman, J. E., & Seaman, J. (2018). Grade increase: Tracking distance education in the United States. *Babson Survey Research Group*. Retrieved from http://onlinelearningsurvey.com/reports/gradeincrease.pdf

Battaglino, T. B., Haldeman, M., & Laurans, E. (2012). The costs of online learning. Creating sound policy for digital learning. *Thomas B. Fordham Institute*. Retrieved from https://eric.ed.gov/?id=ED528948

Bawa, P. (2016). Retention in online courses: Exploring issues and solutions—A literature review. *Sage Open*, *6*(1), 2158244015621777. Retrieved from http://journals.sagepub.com/doi/full/10.1177/2158244015621777

Bersin, J. (2018, July). A new paradigm for corporate training: Learning in the flow of work. *Insights on Corporate Talent, Learning and HR Technology.* Retrieved from https://joshbersin.com/2018/06/a-new-paradigm-for-corporate-training-learning-in-the-flow-of-work/

Blackboard. (2019). About blackboard. Retrieved from https://www.blackboard.com/index.html

Bonk, C. J. (2002). *Online training in an online world*. Bloomington, IN: CourseShare.com.

Borup, J., West, R. E., & Graham, C. R. (2013). The influence of asynchronous video communication on learner social presence: A narrative analysis of four cases. *Distance Education. 34*(1), 48-63. Retrieved from http://dx.doi.org/10.1080/01587919.2013.770427

Brame, C., (2016). Active learning. *Vanderbilt University Center for Teaching.* Retrieved from https://cft.vanderbilt.edu/active-learning/

Brandman University Assessment Office. (2014). *Understanding the Brandman University student opinion survey.* (Report). Retrieved from https://my.brandman.edu/sites/faculty

Brandman University Assessment Office. (September 2016). *Turnitin/Grademark and Livetext: Information and processes.* (Report). Retrieved from https://www.brandman.edu/-/media/documents/cii/grademark_and_livetext_information_and_processes.pdf?la=en&hash=FB12552D9E0AC760A7D2D95C440ACE42EFC97096

Brandman University. (2018). *Brandman University fact book 2017-2018.* (Report). Retrieved from https://www.brandman.edu/-/media/ documents/ marketingresourcedocuments/bu_fact-book_2017.pdf?la=en&hash= 944351EE8F33784CC0EE95D3A06571FF3ADC4596

Chen, N., Hung, C. & Kinshuk. (2012). Embodied interactive video lectures for improving learning comprehension and retention. *Computers & Education, 117*, 116-131. Retrieved from https://www.sciencedirect.com/science/article/pii/S0360131517302312?via%3Dihub

Cherrett, T., Wills, G., Price, J., Maynard, S., & Dror, I. E. (2009). Making training more cognitively effective: Making videos interactive. *British Journal of Educational Technology, 40*(6), 1124-1134. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-8535.2009.00985.x

Ching, Y. H. & Hsu, Y.C. (2013). Collaborative learning using voicethread in an online graduate course. *Knowledge Management & E- Learning: An International Journal, 5*(3), 298–314. Retrieved from http://kmel-journal.org/ojs/index.php/online-publication/article/view/212

Corich, S. (2008). Developing strategies to deal with the multiple generational groupings within the tertiary classroom. *Eastern Institute of Technology Hawke's Bay*, 201-205. Retrieved from http://www.citrenz.ac.nz/conferences/2008/201.pdf

Coursera.com. (2018). Online courses & credentials from top educators. Retrieved from https://www.coursera.org/

Davis, C. A. & Dyckman, C. K. (2008). Part one: The shift toward online education. *Journal of Information Systems Education*, *19*(1), 11-16. Retrieved from https://www.researchgate.net/profile/Kathleen_Davis6/publication/228649898_Part_One-The_Shift_Toward_Online_Education/links/54c670800cf219bbe4f8528a.pdf

Deborah, W. (2006). *Creating community in the virtual classroom: Choosing integrity as a pedagogical tool.* Conference proceeding. Retrieved from http://www.cfkeep.org/uploads/wise.pdf

Delen, E. (2013). *Scaffolding and enhancing learners' self-regulated learning: Testing the effects of online interactive multimedia-based interactive learning environment on learning outcomes.* (Doctoral dissertation). Retrieved from http://oaktrust.library.tamu.edu/handle/1969.1/151123

Downes, S. (2008). Places to go: Connectivism and connective knowledge. *Innovate: Journal of Online Education, 5*(6). Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1037&context=innovate/

Engel, H. A. (1936). *WHA, Wisconsin's pioneer*. Unpublished manuscript. Madison, WI: Wisconsin State Historical Society

Esteves, M, Pereira, A., Veiga, N., Vasco, R. & Veiga, A. (2018). The use of new learning technologies in higher education classroom: A case study. *iJep,* 8(2), 115-127. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-73210-7_59

Fleming, N. D. (2013). VARK: A guide to learning styles. Retrieved from http://vark-learn.com/introduction-to-vark/

Fleming, N. D. & Mills, C. (2018). Research and statistics. Retrieved from http://vark-learn.com/introduction-to-vark/research-statistics/

Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and application (7th ed.).* Columbus, OH: Merrill and Prentice Hall.

Goldin, C. & Katz, L. F. (2008). *The race between education and technology.* New York, NY: Belknap Press.

Harting, K., & Erthal, M. J. (2005). History of distance education. *Information Technology, Learning, and Performance Journal, 23*(1), 35–44.

Hartsell, T., & Yuen, S. (2006). Video streaming in online learning. *Association for the Advancement of Computing in Education Journal*, *14*(1), 31-43. Retrieved from https://www.learntechlib.org/p/6152/

Heick, T. (2017, Sept. 8). A brief history of video games in education. Retrieved from https://www.teachthought.com/technology/a-brief-history-of-video-games-in-education/

Henderson, K. (2016). Reinventing the methods journal: Increasing reproducibility with video journals. *Against the Grain, 25*(5), 9. Retrieved from https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=6605&context=atg

Herbert, M. (2006). Staying the course: A study in online student satisfaction and retention. *Online Journal of Distance Learning Administration, 9*(4), 300-317. Retrieved from http://www.westga.edu/~distance/ojdla/winter94/herbert94.htm

Heyman, E. (2010). *Overcoming student retention issues in higher education online programs: A Delphi study.* (Doctoral dissertation). Retrieved from http://search.proquest.com/docview/748309429?accountid=13360

Hibbert, M. C. (2014). What makes an online instructional video compelling? *Educause Review.* Retrieved from https://er.educause.edu/articles/2014/4/what-makes-an-online-instructional-video-compelling

Hibbert, M. C. (2016). *Student experiences with instructional videos in online learning environments.* (Doctoral dissertation). Retrieved from https://academiccommons.columbia.edu/doi/10.7916/D8HQ3ZZ6

Hofman, W. H. A. & Wieling, M. B. (2010). The impact of online video lecture recordings and automated feedback on student performance. *Computers & Education*, *54*(4), 992–998. Retrieved from https://www.sciencedirect.com/science/article/pii/S0360131509002784

Hotchkiss, J. L. & Shiferaw, M. (2010). Decomposing the education wage gap: Everything but the kitchen sink. *Federal Reserve Bank of St. Louis Review*, *93*(4), 243-71. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1677147

Jensen, U. (2011). Factors influencing student retention in higher education. *Pacific Policy Research Center.* Retrieved from http://www.ksbe.edu/_assets/spi/pdfs/Retention_Brief.pdf

Ke, F. and Chavez, A. F. (2013). *Web-based teaching and learning across culture and age.* New York, NY: Springer Science & Business Media.

Kentnor, H. (2015). Distance education and the evolution of online learning in the United States. *Curriculum and Teaching Dialogue, 17*(1), 21-34. Retrieved from https://digitalcommons.du.edu/cgi/viewcontent.cgi?article=1026&context=law_facpub

Koivula, M. (2018). *The impacts of asynchronous video reflection on perceived learner social presence.* (Doctoral dissertation). Retrieved from https://search-proquest-com.libproxy.chapman.edu/docview/2024633583

Kleinheksel, A. J. (2014). Transformative learning through virtual patient simulations: Predicting critical student reflections. *Clinical Simulation in Nursing*, *10*(6), e301-e308. http://dx.doi.org/10.1016/j.ecns.2014.02.001

Kress, G. (2000). Multimodality: Challenges to thinking about language. *TESOL Quarterly, 34*(2), 337-340. Retrieved from https://www.jstor.org/stable/3587959

Krovitz, G. (2009). Increasing instructor presence in an online course. *Educator's Voice*, *10*(4), 1-7. Retrieved from http://research.poly.edu/~epoly/sites/default/files/Educator_voice.pdf

LAERD Dissertation. (2012). *Types of quantitative research question*. Retrieved from http://dissertation.laerd.com/types-of-quantitative-research-question.php

Lazarevic, B. (2011). *Examining the role of the introductory video in the development of teaching presence in online instruction.* (Doctoral dissertation). Retrieved from http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1011&context=teachlearnstudent

Livetext. (2016). About Livetext*.* Retrieved from http://livetext.com

Mayer, R. E. (2014). *Multimedia instruction.* New York, NY: Springer Science & Business Media.

McMahon, M. (2013). A study of the causes of attrition among adult on a fully online training course. *Irish Journal of Academic Practice, 2*(1), 10. Retrieved from https://arrow.dit.ie/cgi/viewcontent.cgi?article=1017&context=ijap

McMillan, J. H. Schumacher, S. (2010). *Research in education: Evidence-based inquiry.* Pearson Education, Inc.: Upper Saddle River, NJ.

Michelich, V. (2002). Streaming media to enhance teaching and improve learning. *The Technology Source*. Retrieved from ttp://technologysource.org/article/streaming_media_to_enhance_teaching_and_improve_learning/

Moreno, R., & Mayer, R. (2007). Interactive multimodal learning environments. *Educational Psychology Review*, *19*(3), 309-326. Retrieved from https://link.springer.com/article/10.1007/s10648-007-9047-2

Munro, A. R. & Crowley, S. (2019). Interactive media-based instructional design (IMBID) manual. Unpublished Manual retrieved from https://docs.google.com/document/d/1AdRDcnQ7HpvHIFI4ABEK7HcQKMnMOKsTSJSb9Rc_89E/edit?usp=sharing

National Center for Education Statistics (NCES). (2018). College navigator: Brandman University. Retrieved from https://nces.ed.gov/collegenavigator/?q=brandman&s=all&id=262086#enrolmt

Nodine, T. R. (2016). How did we get here? A brief history of competency-based higher education in the United States. *The Journal of Competency-Based Education*, 1(1), 5-11. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1002/cbe2.1004

Online Schools Center. (2018). Getting connected: A brief history of online education. Retrieved from https://www.onlineschoolscenter.com/history-of-online-education/

Ornstein, A. C. & Levine, D. U. (1993). *Foundations of education (5th ed)*. Boston, MA: Houghton.

Oud, J. (2009). Guidelines for effective online instruction using multimedia screencasts. *Reference Services Review*, *37*(2), 164-177. Retrieved from https://www.emeraldinsight.com/doi/abs/10.1108/00907320910957206?journalCode=rsr

Ozan, O. & Ozarslan, Y. (2016). Video lecture watching behaviors of learners in online courses. *Educational Media International, 53*(1), 27-41. Retrieved from https://www.tandfonline.com/doi/full/10.1080/09523987.2016.1189255

Pappano, L. (2012). The year of the MOOC. *New York Times, 2*(12). Retrieved from http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html

Parikh, S. B., Janson, C. & Singleton, T. (2012). Video journaling as a method of reflective practice. *Counselor Education and Supervision, 15*(1), 33-49. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1002/j.1556-6978.2012.00003.x

Patton, M. Q. (2015). *Qualitative research and evaluation methods (3rd ed.)*. Thousand Oaks, CA: Sage.

Peterson-Ahmad, M., (2018). Enhancing pre-service special educator preparation through combined use of virtual simulation and instructional coaching. *Education Sciences, 8*(1), 10. Retrieved from www.mdpi.com/journal/education

Pritsker, M. & Blackwell, L. S. (2013). Scholarly video journals to increase productivity in research and education. *The Serials Librarian, 64(*1-4), 167-170.

Redmond, P. (2017). Talking about my generation: Exploring the benefits engagement challenge. *Global Stock and Reward Services.* Retrieved from https://wealth.barclays.com/content/dam/bwpublic/global/documents/global-stock-rewards/multi-generations-summary.pdf

Roffe, I. (2004). *Innovation and e-learning: E-business for an educational enterprise.* Cardiff, UK: University of Wales Press.

Rumble, G. (1986). *The planning and management of distance education.* London, UK: Croom Helm.

Ryan, C. & Lewis, J. M. (2017). *Computer and Internet use in the united states: 2015.* US Department of Commerce. Economics and Statistics Administration, US Census Bureau. Retrieved from https://www.census.gov/content/dam/Census/library/publications/2017/acs/acs-37.pdf

Saba, F. (2011). Distance education in the United States: Past, present, future. *Educational Technology, (51)*6, 12-18. Retrieved from http://distance-educator.com/wp-content/uploads/ET-article-Saba-11-12-2011.pdf

Schaffhauser, D. (2009). Survey reports many online learners never seek help before dropping out. *THE Journal and Campus Technology.* Retrieved from https://campustechnology.com/articles/2009/01/09/survey-reports-many-online-learners-never-seek-help-before-dropping-out.aspx

Schroer, W. J. (n.d.). Generations X, Y, Z and the others. Retrieved from http://socialmarketing.org/archives/generations-xy-z-and-the-others/

Shah, D. (2018). A product at every price: A review of MOOC stats and trends in 2017. *Class Central*. Retrieved from https://www.classcentral.com/report/moocs-stats-and-trends-2017/

Shelton, K. & Saltsman, G. (2005). *An administrator's guide to online education*. Greenwich, CT: Information Age Publishing.

Siemens, G. (2004). Connectivism: A learning theory for the digital age. Retrieved from http://www.ingedewaard.net/papers/connectivism/2005_siemens_ALearningTheoryForTheDigitalAge.pdf

Simon, M. (2011). Assumptions, limitations and delimitations. *Dissertation and scholarly research: Recipes for success.* Retrieved from http://dissertationrecipes.com/wp-content/uploads/2011/04/AssumptionslimitationsdelimitationsX.pdf

Smith, B. (2010). *E-learning technologies: A comparative study of adult learners enrolled on blended and online campuses engaging in a virtual classroom.* (Doctoral dissertation). Retrieved from https://search-proquest-com.libproxy.chapman.edu/docview/746605945

Soloway, E., Guzdial, M., & Hay, K. E. (1994). Learner-centered design: The challenge for HCI in the 21st century. *Interactions, 1*(2), 36-48.

Tyler-Smith, K. (2006). Early attrition among first time e-learners: A review of factors that contribute to drop-out, withdrawal and non-completion rates of adult learners undertaking e-learning programs. *Journal of Online Learning and Teaching, 2*(2), 73-85. Retrieved from http://jolt.merlot.org/Vol2_No2_TylerSmith.htm

Turnitin. (2019). About Turnitin. Retrieved from http://turnitin.com/about

United States Department of Commerce. (2013). *Computer and Internet use in the United States.* (Current Population Report). Retrieved from https://www.census.gov/prod/2013pubs/p20-569.pdf

United States Department of Education, National Center for Education Statistics. (2013). *Biennial survey of education in the United States, opening fall enrollment in higher education.* (USDE Report). Retrieved from https://nces.ed.gov/programs/digest/d13/tables/dt13_303.10.asp

Verduin, J. R., & Clark, T. A. (1991). *Distance education.* Oxford, UK: Jossey-Bass Publishers.

Vural, O. F. (2013). The impact of a question-embedded interactive multimedia-based learning tool on e-learning. *Education Sciences: Theory & Practice.* 13(2), 1315-1323. Retrieved from https://pdfs.semanticscholar.org/4cd6/7d18f56bdc784ea88e58566c225ff066f913.pdf

Wang, X., Hao, Z., Luo, S., & Ren, M. (2018). A teaching model of urban and rural planning curriculum integrating virtual simulation technology. i*JET*, *13*(6), 149-162. Retrieved from http://online-journals.org/index.php/i-jet/article/view/8584/4998

Winterbottom, M. (2017). Active learning. Cambridge Assessment International Education. Retrieved from http://www.cambridgeinternational.org/images/271174-active-learning.pdf

Wu, J. (2018). A space design teaching model using virtual simulation technology. *iJet,* *13*(6), 163-175. Retrieved from https://doi.org/10.3991/ijet.v13i06.8585

Young, J. R. (2017, March 17). For online class discussion, instructors move from text to video. *EdSurge.* Retrieved from https://www.edsurge.com/news/2017-03-17-for-online-class-discussions-instructors-move-from-text-to-video

Zaker, S. B. (2013). A theoretical and applied model for competency-based education at Brandman University. Unpublished Manuscript, Brandman University, Irvine, CA.

Zhang, D. (2005). Interactive multimedia-based e-learning: A study of effectiveness. The American Journal of Distance Education, 19(3), 149–162. Retrieved from https://www.tandfonline.com/doi/abs/10.1207/s15389286ajde1903_3

Zhang, L. (2006). Effectively incorporating instructional media into web-based information literacy. *The Electronic Library*, *24*(3), 294-306. Retrieved from https://www.emeraldinsight.com/doi/abs/10.1108/02640470610671169

Zhang, D., Zhou, L., Briggs, R. & Nunamaker, J. (2006). Instructional video in e-learning: Assessing the impact of interactive of video on learning effectiveness. *Information & Management, 43*(1), 15-27. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0378720605000170

APPENDICES

APPENDIX A

Synthesis Matrix

Table A

Synthesis Matrix

Researcher	Method	N=	Analysis	Mode	Interactivity	Engage	Perform	Satisfy
Borup et al., 2013	Qualitative	4	Lived experiences of students participating in asynchronous video discussions.	VA	View and Discuss User Control			Y
Chen, Hung, and Kinshuk, 2012	Quantitative Experimental	90	Interactive multimedia-based online lecture. Controllable video-based online lecture. Non-controllable video-based online lecture.	VARK	User Control View and Discuss IVC Hotspot Media		Y	
Cherrett et al., 2009	Quantitative Experimental	75	Interactive multimedia-based module.	VARK	User Control Hotspot Media GBL			Y
Ching & Hsu, 2013	Mixed Method	20	Analysis of survey data and user activity collected at the end of the course.	VAR	View and Discuss User Control			Y
Delen, 2013	Quantitative Experimental	80	Interactive multimedia-based online lecture. Non-Interactive video-based online lecture.	VARK	User Control IVC Hotspot		Y	
Zhang, 2005	Quantitative	155	IMBID vs text-based online lecture.	VAR	User Control		Y	Y
Esteves et al., 2018	Quantitative Experimental	324	Multiple online game-based learning platforms.	VARK	User Control IVC GBL Hotspot Media	Y	Y	
Henderson, 2016	Qualitative	N/A	Video journals to document scientific experiments resulted in better understanding and ability to reproduce experiments than written journals.	VARK	View and Reflect User Control		Y	Y
Kleinheksel, 2014	Quantitative	130	Survey data analysis from students after completing a digital clinical experience simulation.	VARK	Simulation View and Reflect User Control		Y	
Parikh et al., 2011	Qualitative Phenomenological	7	Lived experience of students completing reflective journals. Post activity interview.	VA	View and Reflect	Y		Y
Peterson-Ahmad, 2018	Mixed Method Case Study	8	Simulation participants vs non-simulation students.	VARK	Simulation		Y	
Sapiano et al., 2018	Quantitative	166	Interactive virtual simulation. Pre and Post-test.	VARK	Simulation		Y	
Wang et al., 2018	Quantitative	90	Pre & post-test comparison	VARK	Simulation		Y	

Wu, 2018	Quantitative	46	Survey comparison	VARK	Simulation		Y	Y
Vural, 2013	Quantitative Quasi-Experimental	318	Interactive vs non-interactive video-based quiz.	VARK vs VAR	IVC Simulation	Y	Y	
Zhang et al., 2006	Quantitative	138	Interactive vs non-interactive video-based lecture.	VAR	User Control		Y	Y

APPENDIX B

Sampling Frame Per Course Section

Table B

Sampling Frame Per Course Section

Text-based	Performance N=	Engagement N=	Satisfaction N=	IMBID	Performance N=	Engagement N=	Satisfaction N=
Course 1 TB Section 1	24	24	9	Course 1 IMBID Section 1	25	25	5
Course 1 TB Section 2	26	26	5	Course 1 IMBID Section 2	25	25	13
Course 2 TB Section 1	18	18	8	Course 2 IMBID Section 1	28	28	6
Course 2 TB Section 2	20	20	9	Course 2 IMBID Section 2	19	19	8
Course 2 TB Section 3	32	32	5	Course 2 IMBID Section 3	27	27	13
Course 2 TB Section 4	35	35	10	Course 2 IMBID Section 4	25	25	8
Course 3 TB Section 1	25	25	9	Course 3 IMBID Section 1	20	20	7
Course 3 TB Section 2	19	19	6	Course 3 IMBID Section 2	25	25	8
Course 3 TB Section 3	26	26	11	Course 3 IMBID Section 3	23	23	7
Course 3 TB Section 4	27	27	10	Course 3 IMBID Section 4	21	21	7
Course 4 TB Section 1	26	26	9	Course 4 IMBID Section 1	22	22	7
Course 4 TB Section 2	21	21	11				
Course 5 TB Section 1	17	17	7	Course 5 IMBID Section 1	20	20	7
Course 5 TB Section 2	12	12	4	Course 5 IMBID Section 2	21	21	14
Course 5 TB Section 3	3	3	1	Course 5 IMBID Section 3	21	21	9
Course 5 TB Section 4	4	4	2				
Course 6 TB Section 1	27	27	7	Course 6 IMBID Section 1	17	17	6
Course 6 TB Section 2	18	18	4	Course 6 IMBID Section 2	20	20	8
Course 6 TB Section 3	18	18	15				
Course 7 TB Section 1	23	23	5	Course 7 IMBID Section 1	22	22	10
Course 7 TB Section 2	20	20	9	Course 7 IMBID Section 2	20	20	5
Course 7 TB Section 3	26	26	7				
Course 8 TB Section 1	23	23	7	Course 8 IMBID Section 1	16	16	4
Course 8 TB Section 2	32	32	10				
Course 8 TB Section 3	25	25	13				

Course 8 TB Section 4	22	22	7				
Course 9 TB Section 1	28	28	8	Course 9 IMBID Section 1	33	33	9
Course 9 TB Section 2	24	24	4				
Course 9 TB Section 3	31	31	12				
Course 10 TB Section 1	13	13	3	Course 10 IMBID Section 1	16	16	9
Course 10 TB Section 2	14	14	12	Course 10 IMBID Section 2	7	7	1
Course 10 TB Section 3	20	20	6				
Course 10 TB Section 4	28	28	13				
Course 11 TB Section 1	12	12	4	Course 11 IMBID Section 1	12	12	3
Course 11 TB Section 2	14	14	6	Course 11 IMBID Section 2	20	20	7
Course 11 TB Section 3	11	11	4	Course 11 IMBID Section 3	19	19	6
Course 11 TB Section 4	12	12	7	Course 11 IMBID Section 4	17	17	7
Course 11 TB Section 5	14	14	6				
Course 12 TB Section 1	18	18	5	Course 12 IMBID Section 1	21	21	11
Course 12 TB Section 2	13	13	7	Course 12 IMBID Section 2	17	17	10
Course 12 TB Section 3	17	17	5	Course 12 IMBID Section 3	17	17	10
Course 12 TB Section 4	5	5	4				
Course 13 TB Section 1	16	16	10	Course 13 IMBID Section 1	21	21	6
Course 13 TB Section 2	20	20	5	Course 13 IMBID Section 2	16	16	6
Course 13 TB Section 3	20	20	7	Course 13 IMBID Section 3	19	19	8
				Course 13 IMBID Section 4	19	19	7
Total	899	899	328	**Total**	671	671	252

APPENDIX C

Signature Assignment Rubric Template

Note that the numbers in the upper left side of the cells are for placement only: insert the appropriate score. The exception is "not complete." It must be 0.

Learning Outcome *This column indicates whether the criteria align to the ILO or the PLO or both the ILO and PLO. If it aligns to neither (e.g. it is about writing mechanics), use CLO). If it aligns to two PLOs or two ILOs, note the number of the outcomes.*	***Criteria*** *Identify the grading element or criterion*	**EXEMPLARY** *Write the descriptor for the criteria – this descriptor should represent exemplary work.*	**PROFICIENT** *Write the descriptor for the criteria – this descriptor should represent proficient work.*	**DEVELOPING** *Write the descriptor for the criteria – this descriptor should represent developing work.*	**EMERGING** *Write the descriptor for the criteria – this descriptor should represent emerging work.*	**NOT COMPLETE** *Write the descriptor for the criteria – this descriptor should represent work in which the criteria were not present at all; the assignment was not submitted, and/or the attempt at the criteria was completely unacceptable.*
PLO		4	3	2	1	0
PLO		4	3	2	1	0
ILO		4	3	2	1	0
ILO		4	3	2	1	0
CLO		4	3	2	1	0

Figure C. Brandman University Signature Assignment Rubric Template

(Brandman, 2018)

APPENDIX D

Student Opinion Survey

The Student Opinion Survey is electronically deployed to your students in the 7th week of the session and remains open until the end of the session. Results are available to you on Blackboard after all the grades for the session have been submitted.

Brandman University Student Opinion Survey

Please respond to the following questions about your instructor, the learning environment, the design of the course, and technology.

This survey includes six sections of questions, and should take approximately 8 - 10 minutes to complete.

Instructor Specific/Learning Environment [Section 1 of 6]

My instructor...

1. provided help as needed.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

2. provided feedback in a timely manner.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

3. provided feedback in a useful manner.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

4. used multiple instructional methods.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Figure D. Brandman University Student Opinion Survey (Brandman, 2018)

5. was clear with class instructions/directions/expectations.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

6. communicated course content that was meaningful to me.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

7. was prepared for classes.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

8. facilitated face-to-face and/or WIMBA class discussions and/or group activities.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

9. managed face-to-face and/or WIMBA class time appropriately.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

for the session have been submitted.

Student Opinion: Feelings More Than Experience [Section 2 of 6]

I believe that...

10. I participated fully and put forth my best effort in this class.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

11. my instructor created and maintained a positive learning environment.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

12. my learning was assessed fairly.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

13. my learning was assessed accurately.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

14. my interactions with the instructor were positive.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

15. my interactions with the instructor were professional.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Figure D (continued). Brandman University Student Opinion Survey (Brandman, 2018)

16. I achieved the stated learning objectives/outcomes for this course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

17. my instructor was knowledgeable of/with course content.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Overall Impression of Instructor [Section 3 of 6]

18. Overall, the instructor did an excellent job in this course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Course Design: Structure, Goals, Objectives (Student-Centered) [Page 4 of 6]

This course...

19. met stated learning objectives and goals.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

20. gave opportunities to *demonstrate* understanding *throughout* the class (i.e. offered relevant assessments of learning).

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

21. provided opportunities for quality online interactions (e.g., discussion board, WIMBA).

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Figure D (continued). Brandman University Student Opinion Survey (Brandman, 2018)

22. offered online collaborative work that helped meet course objectives (e.g., group projects, wikis, blogs).

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

23. offered outside independent work that facilitated learning and met course objectives.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

24. provided content/materials that facilitated learning and met course objectives.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

25. provided readings that facilitated learning and met course objectives.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

26. provided assignments that facilitated learning and met course objectives.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

27. provided assessments/test/exams that aligned with course objectives.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Figure D (continued). Brandman University Student Opinion Survey (Brandman, 2018)

Technology [Section 5 of 6]

28. These elements of the course design were user-friendly:

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Not Applicable
WIMBA	○	○	○	○	○	○
Discussion Board	○	○	○	○	○	○
Wiki	○	○	○	○	○	○
Blog	○	○	○	○	○	○
Grade Center	○	○	○	○	○	○

29. I was able to get helpful tech support when I needed it.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

30. I was able to manage the technology demands of the course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

31. I was computer literate before taking this course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

32. My level of comfort using technology has increased during the course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

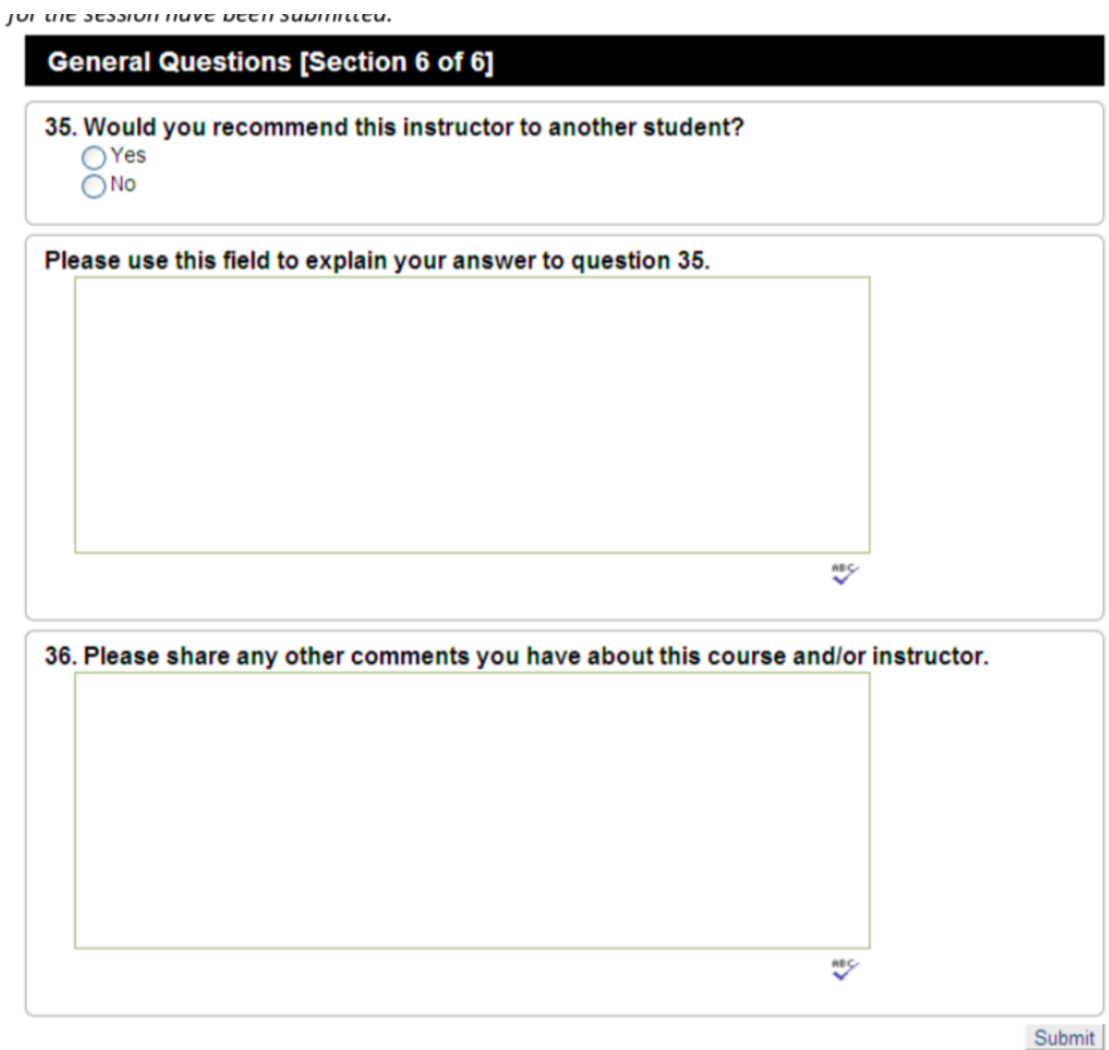
33. I received adequate training to be successful in this course in:

	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
Blackboard, in general	○	○	○	○	○
Blackboard collaboration tools (WIMBA, WIKI's, Email)	○	○	○	○	○
How to submit/turn in my completed work	○	○	○	○	○

34. My Internet connectivity was sufficient/adequate to be successful in this course.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
○	○	○	○	○

Figure D (continued). Brandman University Student Opinion Survey (Brandman, 2018)


for the session have been submitted.

General Questions [Section 6 of 6]

35. Would you recommend this instructor to another student?

- Yes
- No

Please use this field to explain your answer to question 35.

36. Please share any other comments you have about this course and/or instructor.

Submit

Figure D (continued). Brandman University Student Opinion Survey (Brandman, 2018)

APPENDIX E

Student Performance

Table E

Student Performance Data

Student Performance Text-Based		Student Performance IMBID	
Batch UID	Text-Based SA GRADE	Batch UID	IMBID SA GRADE
Course 1	60.00	Course 1	75.00
Course 1	73.33	Course 1	75.69
Course 1	80.00	Course 1	76.00
Course 1	80.00	Course 1	77.15
Course 1	86.67	Course 1	77.56
Course 1	86.67	Course 1	79.31
Course 1	86.67	Course 1	80.00
Course 1	90.67	Course 1	81.00
Course 1	90.67	Course 1	81.32
Course 1	93.33	Course 1	82.00
Course 1	93.33	Course 1	82.85
Course 1	93.33	Course 1	82.95
Course 1	93.33	Course 1	83.69
Course 1	96.00	Course 1	84.20
Course 1	97.33	Course 1	84.41
Course 1	97.33	Course 1	86.41
Course 1	98.67	Course 1	86.75
Course 1	98.67	Course 1	87.80
Course 1	98.67	Course 1	89.22
Course 1	98.67	Course 1	90.00
Course 1	98.67	Course 1	90.34
Course 1	98.67	Course 1	91.22
Course 1	98.67	Course 1	92.00
Course 1	98.67	Course 1	92.47
Course 1	99.33	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	96.27
Course 1	100.00	Course 1	98.00
Course 2	45.78	Course 2	60.00
Course 2	52.71	Course 2	75.50
Course 2	59.53	Course 2	80.00
Course 2	59.94	Course 2	81.00
Course 2	60.00	Course 2	82.50
Course 2	61.97	Course 2	82.50
Course 2	63.31	Course 2	83.50
Course 2	63.36	Course 2	84.50

Course 2	63.76	Course 2	85.00
Course 2	63.97	Course 2	85.00
Course 2	64.60	Course 2	85.00
Course 2	65.00	Course 2	85.00
Course 2	65.00	Course 2	85.00
Course 2	65.57	Course 2	86.50
Course 2	65.80	Course 2	87.00
Course 2	65.87	Course 2	87.50
Course 2	67.25	Course 2	88.50
Course 2	73.10	Course 2	88.50
Course 2	73.36	Course 2	90.00
Course 2	73.97	Course 2	90.00
Course 2	75.20	Course 2	90.00
Course 2	75.43	Course 2	90.00
Course 2	76.15	Course 2	90.00
Course 2	77.27	Course 2	90.00
Course 2	77.54	Course 2	95.00
Course 2	78.27	Course 2	95.00
Course 2	79.17	Course 2	95.00
Course 2	79.40	Course 2	95.00
Course 2	79.63	Course 2	95.00
Course 2	80.06	Course 2	95.00
Course 2	82.59	Course 2	95.00
Course 2	83.92	Course 2	95.00
Course 2	86.64	Course 2	97.50
Course 2	93.37	Course 2	98.00
Course 2	96.04	Course 2	100.00
Course 3	80.00	Course 3	92.00
Course 3	80.00	Course 3	94.00
Course 3	91.00	Course 3	94.00
Course 3	91.00	Course 3	95.00
Course 3	91.00	Course 3	97.00
Course 3	94.00	Course 3	97.00
Course 3	94.00	Course 3	97.00
Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
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Course 3	97.00	Course 3	100.00
Course 3	98.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
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Course 3	100.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
Course 4	81.25	Course 4	100.00
Course 4	81.25	Course 4	100.00
Course 4	81.25	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	96.88
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	90.63
Course 4	100.00	Course 4	90.63
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 5	98.00	Course 5	98.00
Course 5	100.00	Course 5	98.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	84.00	Course 5	86.00
Course 5	84.00	Course 5	90.00
Course 5	92.00	Course 5	90.00
Course 5	92.00	Course 5	90.00
Course 5	92.00	Course 5	92.00
Course 5	92.00	Course 5	92.00
Course 5	92.00	Course 5	93.00
Course 5	92.00	Course 5	94.00
Course 5	98.00	Course 5	94.00
Course 5	98.00	Course 5	94.00
Course 5	98.00	Course 5	95.00
Course 5	98.00	Course 5	96.00
Course 5	98.00	Course 5	98.00
Course 5	100.00	Course 5	98.00
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Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 6	81.33	Course 6	85.33
Course 6	100.00	Course 6	88.67
Course 6	90.00	Course 6	90.00
Course 6	90.00	Course 6	93.33
Course 6	90.00	Course 6	93.33
Course 6	90.67	Course 6	93.33
Course 6	83.33	Course 6	93.33
Course 6	83.33	Course 6	94.67
Course 6	92.00	Course 6	95.33
Course 6	93.33	Course 6	96.00
Course 6	93.33	Course 6	96.67
Course 6	93.33	Course 6	96.67
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Course 6	93.33	Course 6	99.33
Course 6	93.33	Course 6	99.33
Course 6	94.00	Course 6	100.00
Course 6	90.00	Course 6	96.67
Course 6	90.00	Course 6	98.00
Course 6	93.33	Course 6	99.33
Course 6	93.33	Course 6	99.33
Course 6	94.00	Course 6	90.00
Course 6	94.00	Course 6	93.33
Course 6	94.67	Course 6	100.00
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Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	97.33	Course 6	100.00
Course 7	70.00	Course 7	86.67
Course 7	73.33	Course 7	92.00
Course 7	73.33	Course 7	92.00
Course 7	80.00	Course 7	92.00
Course 7	80.00	Course 7	92.67
Course 7	80.00	Course 7	93.33
Course 7	83.33	Course 7	93.33
Course 7	86.67	Course 7	93.33
Course 7	93.33	Course 7	93.33
Course 7	93.33	Course 7	93.33
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00

Course 7	94.00	Course 7	94.67
Course 7	96.00	Course 7	95.33
Course 7	96.67	Course 7	96.67
Course 7	96.67	Course 7	97.33
Course 7	96.67	Course 7	98.00
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
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Course 7	98.67	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 8	70.00	Course 8	98.67
Course 8	71.00	Course 8	99.33
Course 8	85.00	Course 8	95.33
Course 8	94.00	Course 8	98.67
Course 8	95.00	Course 8	100.00
Course 8	95.00	Course 8	96.67
Course 8	96.00	Course 8	94.67
Course 8	96.00	Course 8	96.67
Course 8	97.00	Course 8	100.00
Course 8	97.00	Course 8	94.67
Course 8	97.00	Course 8	100.00
Course 8	97.00	Course 8	100.00
Course 8	100.00	Course 8	90.00
Course 8	100.00	Course 8	100.00
Course 8	100.00	Course 8	100.00
Course 8	100.00	Course 8	100.00
Course 9	78.00	Course 9	77.50
Course 9	84.00	Course 9	80.00
Course 9	84.00	Course 9	90.00
Course 9	85.00	Course 9	90.00
Course 9	85.00	Course 9	90.00
Course 9	85.00	Course 9	92.50
Course 9	85.50	Course 9	95.00
Course 9	86.00	Course 9	95.00
Course 9	86.50	Course 9	95.00
Course 9	86.50	Course 9	95.00
Course 9	87.00	Course 9	95.00
Course 9	87.50	Course 9	95.00
Course 9	87.50	Course 9	97.50
Course 9	88.50	Course 9	97.50
Course 9	88.50	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50

Course 9	89.50	Course 9	97.50
Course 9	89.50	Course 9	97.50
Course 9	89.50	Course 9	97.50
Course 9	90.00	Course 9	97.50
Course 9	90.00	Course 9	97.50
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.50	Course 9	100.00
Course 9	97.50	Course 9	100.00
Course 10	88.00	Course 10	77.33
Course 10	88.00	Course 10	94.67
Course 10	88.00	Course 10	94.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	93.00	Course 10	100.00
Course 10	94.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 11	72.00	Course 11	83.33
Course 11	76.00	Course 11	84.00
Course 11	82.00	Course 11	84.00
Course 11	82.00	Course 11	90.00
Course 11	85.00	Course 11	92.00
Course 11	85.00	Course 11	92.00
Course 11	89.00	Course 11	93.33
Course 11	90.00	Course 11	93.33
Course 11	90.00	Course 11	93.33
Course 11	90.00	Course 11	94.67
Course 11	90.00	Course 11	94.67
Course 11	92.00	Course 11	94.67
Course 11	92.00	Course 11	95.33
Course 11	92.00	Course 11	96.00
Course 11	93.00	Course 11	96.00
Course 11	93.00	Course 11	96.67
Course 11	93.00	Course 11	96.67
Course 11	94.00	Course 11	96.67
Course 11	94.00	Course 11	97.33
Course 11	95.00	Course 11	97.33
Course 11	95.00	Course 11	97.33
Course 11	95.00	Course 11	98.00

Course 11	95.00	Course 11	98.00
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	100.00
Course 11	95.00	Course 11	100.00
Course 11	96.00	Course 11	100.00
Course 11	96.00	Course 11	100.00
Course 11	97.00	Course 11	100.00
Course 11	98.00	Course 11	100.00
Course 11	98.00	Course 11	100.00
Course 11	100.00	Course 11	100.00
Course 11	100.00	Course 11	100.00
Course 12	52	Course 12	91
Course 12	68	Course 12	94
Course 12	68	Course 12	97
Course 12	68	Course 12	97
Course 12	76	Course 12	97
Course 12	76	Course 12	97
Course 12	76	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	100	Course 12	98
Course 12	100	Course 12	98
Course 12	100	Course 12	98
Course 12	100	Course 12	99
Course 12	100	Course 12	100
Course 12	100	Course 12	100
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Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 13	67.86	Course 13	91.00
Course 13	67.86	Course 13	100.00
Course 13	67.86	Course 13	100.00
Course 13	67.86	Course 13	94.00
Course 13	71.43	Course 13	94.00
Course 13	71.43	Course 13	97.00
Course 13	71.43	Course 13	97.00
Course 13	82.14	Course 13	97.00

Course 13	82.14	Course 13	97.00
Course 13	82.14	Course 13	100.00
Course 13	82.14	Course 13	85.00
Course 13	82.14	Course 13	86.00
Course 13	100.00	Course 13	88.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	97.00
Course 13	100.00	Course 13	97.00
Course 13	100.00	Course 13	97.00
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Course 13	100.00	Course 13	97.00
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Course 13	100.00	Course 13	97.00
Course 13	100.00	Course 13	97.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	83.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	94.00
Course 13	100.00	Course 13	96.00

APPENDIX F

Student Engagement

Table F1

Student Engagement Data: Student Submissions to Collaborative Tools

Student Performance Text-Based		Student Performance IMBID	
Batch UID	Text-Based SA GRADE	Batch UID	IMBID SA GRADE
Course 1	60.00	Course 1	75.00
Course 1	73.33	Course 1	75.69
Course 1	80.00	Course 1	76.00
Course 1	80.00	Course 1	77.15
Course 1	86.67	Course 1	77.56
Course 1	86.67	Course 1	79.31
Course 1	86.67	Course 1	80.00
Course 1	90.67	Course 1	81.00
Course 1	90.67	Course 1	81.32
Course 1	93.33	Course 1	82.00
Course 1	93.33	Course 1	82.85
Course 1	93.33	Course 1	82.95
Course 1	93.33	Course 1	83.69
Course 1	96.00	Course 1	84.20
Course 1	97.33	Course 1	84.41
Course 1	97.33	Course 1	86.41
Course 1	98.67	Course 1	86.75
Course 1	98.67	Course 1	87.80
Course 1	98.67	Course 1	89.22
Course 1	98.67	Course 1	90.00
Course 1	98.67	Course 1	90.34
Course 1	98.67	Course 1	91.22
Course 1	98.67	Course 1	92.00
Course 1	98.67	Course 1	92.47
Course 1	99.33	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	95.00
Course 1	100.00	Course 1	96.27
Course 1	100.00	Course 1	98.00
Course 2	45.78	Course 2	60.00
Course 2	52.71	Course 2	75.50
Course 2	59.53	Course 2	80.00
Course 2	59.94	Course 2	81.00
Course 2	60.00	Course 2	82.50
Course 2	61.97	Course 2	82.50
Course 2	63.31	Course 2	83.50
Course 2	63.36	Course 2	84.50

Course 2	63.76	Course 2	85.00
Course 2	63.97	Course 2	85.00
Course 2	64.60	Course 2	85.00
Course 2	65.00	Course 2	85.00
Course 2	65.00	Course 2	85.00
Course 2	65.57	Course 2	86.50
Course 2	65.80	Course 2	87.00
Course 2	65.87	Course 2	87.50
Course 2	67.25	Course 2	88.50
Course 2	73.10	Course 2	88.50
Course 2	73.36	Course 2	90.00
Course 2	73.97	Course 2	90.00
Course 2	75.20	Course 2	90.00
Course 2	75.43	Course 2	90.00
Course 2	76.15	Course 2	90.00
Course 2	77.27	Course 2	90.00
Course 2	77.54	Course 2	95.00
Course 2	78.27	Course 2	95.00
Course 2	79.17	Course 2	95.00
Course 2	79.40	Course 2	95.00
Course 2	79.63	Course 2	95.00
Course 2	80.06	Course 2	95.00
Course 2	82.59	Course 2	95.00
Course 2	83.92	Course 2	95.00
Course 2	86.64	Course 2	97.50
Course 2	93.37	Course 2	98.00
Course 2	96.04	Course 2	100.00
Course 3	80.00	Course 3	92.00
Course 3	80.00	Course 3	94.00
Course 3	91.00	Course 3	94.00
Course 3	91.00	Course 3	95.00
Course 3	91.00	Course 3	97.00
Course 3	94.00	Course 3	97.00
Course 3	94.00	Course 3	97.00
Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
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Course 3	97.00	Course 3	100.00
Course 3	97.00	Course 3	100.00
Course 3	98.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
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Course 3	100.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
Course 3	100.00	Course 3	100.00
Course 4	81.25	Course 4	100.00
Course 4	81.25	Course 4	100.00
Course 4	81.25	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	96.88
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	87.50	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	90.63
Course 4	100.00	Course 4	90.63
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 4	100.00	Course 4	100.00
Course 5	98.00	Course 5	98.00
Course 5	100.00	Course 5	98.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	84.00	Course 5	86.00
Course 5	84.00	Course 5	90.00
Course 5	92.00	Course 5	90.00
Course 5	92.00	Course 5	90.00
Course 5	92.00	Course 5	92.00
Course 5	92.00	Course 5	92.00
Course 5	92.00	Course 5	93.00
Course 5	92.00	Course 5	94.00
Course 5	98.00	Course 5	94.00
Course 5	98.00	Course 5	94.00
Course 5	98.00	Course 5	95.00
Course 5	98.00	Course 5	96.00
Course 5	98.00	Course 5	98.00
Course 5	100.00	Course 5	98.00
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Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 5	100.00	Course 5	100.00
Course 6	81.33	Course 6	85.33
Course 6	100.00	Course 6	88.67
Course 6	90.00	Course 6	90.00
Course 6	90.00	Course 6	93.33
Course 6	90.00	Course 6	93.33
Course 6	90.67	Course 6	93.33
Course 6	83.33	Course 6	93.33
Course 6	83.33	Course 6	94.67
Course 6	92.00	Course 6	95.33
Course 6	93.33	Course 6	96.00
Course 6	93.33	Course 6	96.67
Course 6	93.33	Course 6	96.67
Course 6	93.33	Course 6	96.67
Course 6	93.33	Course 6	98.00
Course 6	93.33	Course 6	99.33
Course 6	93.33	Course 6	99.33
Course 6	94.00	Course 6	100.00
Course 6	90.00	Course 6	96.67
Course 6	90.00	Course 6	98.00
Course 6	93.33	Course 6	99.33
Course 6	93.33	Course 6	99.33
Course 6	94.00	Course 6	90.00
Course 6	94.00	Course 6	93.33
Course 6	94.67	Course 6	100.00
Course 6	96.00	Course 6	100.00
Course 6	96.00	Course 6	100.00
Course 6	96.00	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	96.67	Course 6	100.00
Course 6	97.33	Course 6	100.00
Course 7	70.00	Course 7	86.67
Course 7	73.33	Course 7	92.00
Course 7	73.33	Course 7	92.00
Course 7	80.00	Course 7	92.00
Course 7	80.00	Course 7	92.67
Course 7	80.00	Course 7	93.33
Course 7	83.33	Course 7	93.33
Course 7	86.67	Course 7	93.33
Course 7	93.33	Course 7	93.33
Course 7	93.33	Course 7	93.33
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00
Course 7	93.33	Course 7	94.00

Course 7	94.00	Course 7	94.67
Course 7	96.00	Course 7	95.33
Course 7	96.67	Course 7	96.67
Course 7	96.67	Course 7	97.33
Course 7	96.67	Course 7	98.00
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	98.67
Course 7	96.67	Course 7	100.00
Course 7	98.67	Course 7	100.00
Course 7	98.67	Course 7	100.00
Course 7	98.67	Course 7	100.00
Course 7	98.67	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 7	100.00	Course 7	100.00
Course 8	70.00	Course 8	98.67
Course 8	71.00	Course 8	99.33
Course 8	85.00	Course 8	95.33
Course 8	94.00	Course 8	98.67
Course 8	95.00	Course 8	100.00
Course 8	95.00	Course 8	96.67
Course 8	96.00	Course 8	94.67
Course 8	96.00	Course 8	96.67
Course 8	97.00	Course 8	100.00
Course 8	97.00	Course 8	94.67
Course 8	97.00	Course 8	100.00
Course 8	97.00	Course 8	100.00
Course 8	100.00	Course 8	90.00
Course 8	100.00	Course 8	100.00
Course 8	100.00	Course 8	100.00
Course 8	100.00	Course 8	100.00
Course 9	78.00	Course 9	77.50
Course 9	84.00	Course 9	80.00
Course 9	84.00	Course 9	90.00
Course 9	85.00	Course 9	90.00
Course 9	85.00	Course 9	90.00
Course 9	85.00	Course 9	92.50
Course 9	85.50	Course 9	95.00
Course 9	86.00	Course 9	95.00
Course 9	86.50	Course 9	95.00
Course 9	86.50	Course 9	95.00
Course 9	87.00	Course 9	95.00
Course 9	87.50	Course 9	95.00
Course 9	87.50	Course 9	97.50
Course 9	88.50	Course 9	97.50
Course 9	88.50	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50
Course 9	89.00	Course 9	97.50

Course 9	89.50	Course 9	97.50
Course 9	89.50	Course 9	97.50
Course 9	89.50	Course 9	97.50
Course 9	90.00	Course 9	97.50
Course 9	90.00	Course 9	97.50
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	90.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.00	Course 9	100.00
Course 9	91.50	Course 9	100.00
Course 9	97.50	Course 9	100.00
Course 10	88.00	Course 10	77.33
Course 10	88.00	Course 10	94.67
Course 10	88.00	Course 10	94.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	90.00	Course 10	98.67
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	92.00	Course 10	100.00
Course 10	93.00	Course 10	100.00
Course 10	94.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	95.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 10	96.00	Course 10	100.00
Course 11	72.00	Course 11	83.33
Course 11	76.00	Course 11	84.00
Course 11	82.00	Course 11	84.00
Course 11	82.00	Course 11	90.00
Course 11	85.00	Course 11	92.00
Course 11	85.00	Course 11	92.00
Course 11	89.00	Course 11	93.33
Course 11	90.00	Course 11	93.33
Course 11	90.00	Course 11	93.33
Course 11	90.00	Course 11	94.67
Course 11	90.00	Course 11	94.67
Course 11	92.00	Course 11	94.67
Course 11	92.00	Course 11	95.33
Course 11	92.00	Course 11	96.00
Course 11	93.00	Course 11	96.00
Course 11	93.00	Course 11	96.67
Course 11	93.00	Course 11	96.67
Course 11	94.00	Course 11	96.67
Course 11	94.00	Course 11	97.33
Course 11	95.00	Course 11	97.33
Course 11	95.00	Course 11	97.33
Course 11	95.00	Course 11	98.00

Course 11	95.00	Course 11	98.00
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	99.33
Course 11	95.00	Course 11	100.00
Course 11	95.00	Course 11	100.00
Course 11	96.00	Course 11	100.00
Course 11	96.00	Course 11	100.00
Course 11	97.00	Course 11	100.00
Course 11	98.00	Course 11	100.00
Course 11	98.00	Course 11	100.00
Course 11	100.00	Course 11	100.00
Course 11	100.00	Course 11	100.00
Course 12	52	Course 12	91
Course 12	68	Course 12	94
Course 12	68	Course 12	97
Course 12	68	Course 12	97
Course 12	76	Course 12	97
Course 12	76	Course 12	97
Course 12	76	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	80	Course 12	97
Course 12	100	Course 12	98
Course 12	100	Course 12	98
Course 12	100	Course 12	98
Course 12	100	Course 12	99
Course 12	100	Course 12	100
Course 12	100	Course 12	100
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Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 12	100	Course 12	100
Course 13	67.86	Course 13	91.00
Course 13	67.86	Course 13	100.00
Course 13	67.86	Course 13	100.00
Course 13	67.86	Course 13	94.00
Course 13	71.43	Course 13	94.00
Course 13	71.43	Course 13	97.00
Course 13	71.43	Course 13	97.00
Course 13	82.14	Course 13	97.00

Course 13	82.14	Course 13	97.00
Course 13	82.14	Course 13	100.00
Course 13	82.14	Course 13	85.00
Course 13	82.14	Course 13	86.00
Course 13	100.00	Course 13	88.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	97.00
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Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	100.00
Course 13	100.00	Course 13	83.00
Course 13	100.00	Course 13	91.00
Course 13	100.00	Course 13	94.00
Course 13	100.00	Course 13	96.00

Table F2

Student Engagement Data: Student Time Spent in Course

Student Time Spent Text-Based		Student Time Spent IMBID	
Batch UID	Text-Based Total Time Spent	Batch UID	IMBID Total Time Spent
Course 1	1.42	Course 1	27.76
Course 1	4.67	Course 1	31.37
Course 1	6.27	Course 1	33.64
Course 1	11.27	Course 1	33.97
Course 1	13.75	Course 1	34.89
Course 1	14.43	Course 1	35.97
Course 1	15.64	Course 1	36.21
Course 1	15.94	Course 1	41.54
Course 1	16.42	Course 1	41.91
Course 1	18.03	Course 1	43.40
Course 1	20.07	Course 1	47.89
Course 1	20.45	Course 1	48.62
Course 1	20.83	Course 1	49.81
Course 1	22.54	Course 1	50.11
Course 1	25.00	Course 1	50.74
Course 1	30.87	Course 1	52.41
Course 1	31.95	Course 1	53.41
Course 1	32.10	Course 1	53.60

Course 1	33.50	Course 1	54.74
Course 1	35.14	Course 1	55.08
Course 1	35.16	Course 1	56.80
Course 1	35.45	Course 1	60.08
Course 1	35.69	Course 1	62.51
Course 1	35.70	Course 1	62.64
Course 1	38.16	Course 1	63.02
Course 1	39.64	Course 1	64.36
Course 1	41.63	Course 1	67.30
Course 1	42.56	Course 1	68.58
Course 1	46.85	Course 1	69.09
Course 1	48.20	Course 1	69.39
Course 1	49.97	Course 1	71.55
Course 1	55.19	Course 1	78.59
Course 1	56.90	Course 1	79.47
Course 1	59.78	Course 1	85.27
Course 1	60.62	Course 1	87.56
Course 2	40.51	Course 2	151.35
Course 2	42.25	Course 2	160.39
Course 2	42.33	Course 2	164.29
Course 2	43.67	Course 2	166.96
Course 2	44.42	Course 2	180.15
Course 2	44.81	Course 2	207.02
Course 2	49.22	Course 2	208.03
Course 2	50.24	Course 2	226.12
Course 2	52.64	Course 2	227.95
Course 2	53.08	Course 2	228.75
Course 2	53.29	Course 2	233.64
Course 2	55.88	Course 2	237.66
Course 2	56.85	Course 2	241.00
Course 2	56.95	Course 2	251.32
Course 2	57.46	Course 2	265.74
Course 2	58.26	Course 2	273.52
Course 2	63.67	Course 2	277.51
Course 2	64.05	Course 2	280.80
Course 2	64.70	Course 2	281.58
Course 2	66.86	Course 2	319.83
Course 2	66.89	Course 2	326.55
Course 2	67.67	Course 2	328.69
Course 2	75.07	Course 2	329.95
Course 2	81.08	Course 2	332.54
Course 2	81.52	Course 2	360.35
Course 2	89.26	Course 2	370.26
Course 2	91.39	Course 2	378.12
Course 2	97.74	Course 2	401.98
Course 2	115.26	Course 2	438.53
Course 2	120.60	Course 2	444.30
Course 2	139.61	Course 2	461.42
Course 2	182.07	Course 2	499.99
Course 2	183.58	Course 2	507.30
Course 2	200.81	Course 2	513.66
Course 2	228.73	Course 2	518.27
Course 3	31.26	Course 3	50.87
Course 3	31.53	Course 3	61.59
Course 3	31.56	Course 3	63.88
Course 3	32.38	Course 3	68.51

Course 3	32.49	Course 3	69.02
Course 3	32.51	Course 3	69.06
Course 3	34.04	Course 3	70.04
Course 3	34.21	Course 3	76.07
Course 3	34.25	Course 3	76.29
Course 3	34.25	Course 3	90.93
Course 3	34.99	Course 3	110.13
Course 3	35.10	Course 3	113.86
Course 3	36.00	Course 3	121.22
Course 3	37.26	Course 3	122.39
Course 3	37.40	Course 3	122.67
Course 3	38.08	Course 3	122.85
Course 3	38.10	Course 3	125.54
Course 3	39.14	Course 3	127.41
Course 3	40.21	Course 3	133.73
Course 3	40.24	Course 3	133.75
Course 3	40.55	Course 3	136.15
Course 3	41.06	Course 3	136.54
Course 3	41.23	Course 3	137.31
Course 3	42.58	Course 3	138.05
Course 3	43.71	Course 3	146.24
Course 3	44.44	Course 3	164.84
Course 3	44.75	Course 3	168.56
Course 3	45.26	Course 3	195.32
Course 3	45.41	Course 3	215.29
Course 3	46.09	Course 3	218.89
Course 3	46.72	Course 3	228.62
Course 3	47.02	Course 3	232.46
Course 3	47.43	Course 3	235.72
Course 3	51.57	Course 3	236.27
Course 3	52.56	Course 3	240.26
Course 4	39.72	Course 4	42.25
Course 4	40.47	Course 4	62.75
Course 4	42.37	Course 4	40.76
Course 4	42.37	Course 4	73.66
Course 4	43.14	Course 4	60.53
Course 4	47.89	Course 4	40.06
Course 4	48.55	Course 4	44.17
Course 4	48.97	Course 4	35.53
Course 4	50.12	Course 4	591.94
Course 4	51.30	Course 4	30.46
Course 4	51.50	Course 4	52.43
Course 4	51.97	Course 4	367.10
Course 4	56.22	Course 4	715.79
Course 4	61.60	Course 4	60.94
Course 4	64.69	Course 4	64.05
Course 4	65.27	Course 4	103.18
Course 4	65.52	Course 4	79.68
Course 4	66.99	Course 4	46.73
Course 4	67.01	Course 4	717.16
Course 4	67.02	Course 4	619.21
Course 4	67.77	Course 4	84.42
Course 4	72.48	Course 4	51.62
Course 5	1.29	Course 5	29.73
Course 5	1.64	Course 5	31.09
Course 5	3.14	Course 5	31.11

Course 5	1.13	Course 5	36.02
Course 5	1.29	Course 5	36.11
Course 5	1.64	Course 5	36.41
Course 5	3.14	Course 5	36.44
Course 5	4.66	Course 5	38.93
Course 5	5.71	Course 5	39.14
Course 5	9.31	Course 5	40.64
Course 5	11.72	Course 5	41.07
Course 5	13.98	Course 5	42.05
Course 5	14.29	Course 5	45.06
Course 5	18.18	Course 5	46.25
Course 5	18.64	Course 5	52.22
Course 5	20.16	Course 5	52.60
Course 5	21.34	Course 5	59.90
Course 5	21.36	Course 5	60.10
Course 5	22.14	Course 5	61.15
Course 5	23.21	Course 5	63.98
Course 5	23.48	Course 5	66.02
Course 5	24.48	Course 5	67.04
Course 5	31.18	Course 5	68.39
Course 5	36.11	Course 5	74.61
Course 5	38.54	Course 5	79.43
Course 5	39.65	Course 5	80.84
Course 5	40.33	Course 5	80.91
Course 5	41.11	Course 5	83.63
Course 5	43.87	Course 5	111.88
Course 5	45.23	Course 5	138.93
Course 5	46.85	Course 5	140.32
Course 5	49.95	Course 5	140.45
Course 5	69.66	Course 5	142.36
Course 5	69.96	Course 5	215.47
Course 5	91.06	Course 5	820.08
Course 6	26.18	Course 6	29.23
Course 6	26.60	Course 6	29.99
Course 6	27.47	Course 6	49.31
Course 6	27.85	Course 6	62.45
Course 6	27.99	Course 6	82.22
Course 6	32.59	Course 6	121.50
Course 6	33.14	Course 6	124.22
Course 6	36.17	Course 6	126.07
Course 6	37.42	Course 6	134.22
Course 6	38.75	Course 6	142.22
Course 6	39.05	Course 6	142.42
Course 6	40.34	Course 6	143.86
Course 6	41.36	Course 6	146.47
Course 6	41.64	Course 6	150.13
Course 6	42.96	Course 6	153.68
Course 6	44.25	Course 6	161.40
Course 6	44.72	Course 6	192.04
Course 6	46.75	Course 6	200.46
Course 6	47.50	Course 6	214.82
Course 6	48.18	Course 6	219.51
Course 6	49.21	Course 6	222.30
Course 6	49.61	Course 6	223.40
Course 6	50.69	Course 6	230.14
Course 6	51.89	Course 6	242.25

Course 6	52.31	Course 6	244.11
Course 6	53.68	Course 6	249.29
Course 6	53.90	Course 6	269.46
Course 6	57.85	Course 6	275.47
Course 6	57.86	Course 6	278.08
Course 6	57.91	Course 6	298.19
Course 6	61.55	Course 6	324.25
Course 6	66.06	Course 6	331.32
Course 6	66.17	Course 6	339.25
Course 6	67.48	Course 6	559.87
Course 6	68.41	Course 6	593.25
Course 7	18.21	Course 7	117.49
Course 7	18.60	Course 7	123.75
Course 7	19.12	Course 7	130.57
Course 7	19.74	Course 7	132.03
Course 7	19.80	Course 7	135.90
Course 7	20.09	Course 7	147.87
Course 7	20.19	Course 7	155.86
Course 7	20.22	Course 7	157.47
Course 7	21.27	Course 7	162.76
Course 7	21.46	Course 7	175.97
Course 7	22.4	Course 7	221.86
Course 7	23.29	Course 7	221.90
Course 7	23.49	Course 7	222.06
Course 7	23.67	Course 7	222.55
Course 7	24.47	Course 7	224.50
Course 7	25.51	Course 7	224.96
Course 7	25.90	Course 7	229.14
Course 7	26.55	Course 7	234.02
Course 7	26.91	Course 7	237.16
Course 7	27.02	Course 7	243.05
Course 7	27.04	Course 7	244.68
Course 7	27.59	Course 7	246.02
Course 7	27.76	Course 7	247.14
Course 7	27.89	Course 7	250.61
Course 7	28.31	Course 7	251.99
Course 7	28.69	Course 7	262.23
Course 7	29.47	Course 7	267.18
Course 7	32.16	Course 7	271.46
Course 7	32.41	Course 7	316.58
Course 7	32.47	Course 7	318.21
Course 7	32.81	Course 7	332.56
Course 7	34.11	Course 7	339.27
Course 7	36.60	Course 7	481.17
Course 7	36.66	Course 7	498.36
Course 7	36.95	Course 7	512.75
Course 8	30.89	Course 8	433.51
Course 8	31.15	Course 8	124.91
Course 8	32.00	Course 8	129.50
Course 8	32.13	Course 8	130.48
Course 8	32.45	Course 8	430.86
Course 8	32.68	Course 8	136.14
Course 8	33.66	Course 8	235.32
Course 8	34.23	Course 8	269.08
Course 8	34.64	Course 8	653.06
Course 8	34.68	Course 8	452.71

Course 8	34.71	Course 8	610.66
Course 8	35.57	Course 8	339.71
Course 8	36.69	Course 8	310.11
Course 8	36.72	Course 8	336.56
Course 8	37.13	Course 8	126.38
Course 8	37.54	Course 8	422.74
Course 9	24.53	Course 9	115.49
Course 9	24.72	Course 9	4.67
Course 9	25.16	Course 9	114.78
Course 9	25.25	Course 9	124.76
Course 9	25.84	Course 9	155.61
Course 9	26.70	Course 9	154.76
Course 9	26.83	Course 9	225.57
Course 9	26.94	Course 9	122.85
Course 9	26.97	Course 9	32.57
Course 9	27.62	Course 9	30.02
Course 9	27.64	Course 9	24.08
Course 9	27.93	Course 9	340.34
Course 9	28.24	Course 9	212.14
Course 9	28.45	Course 9	291.07
Course 9	30.88	Course 9	115.46
Course 9	31.20	Course 9	125.09
Course 9	31.61	Course 9	22.05
Course 9	32.57	Course 9	20.89
Course 9	32.62	Course 9	118.14
Course 9	32.87	Course 9	869.7
Course 9	33.11	Course 9	125.06
Course 9	33.80	Course 9	344.05
Course 9	34.63	Course 9	244.14
Course 9	35.73	Course 9	222.26
Course 9	36.06	Course 9	222.45
Course 9	36.10	Course 9	236.26
Course 9	36.28	Course 9	150.28
Course 9	36.81	Course 9	135.07
Course 9	38.33	Course 9	295.99
Course 9	39.05	Course 9	226.15
Course 9	41.88	Course 9	154.64
Course 9	42.34	Course 9	128.12
Course 9	42.62	Course 9	26.72
Course 10	21.01	Course 10	18.47
Course 10	21.35	Course 10	19.73
Course 10	22.85	Course 10	26.94
Course 10	23.98	Course 10	27.87
Course 10	23.99	Course 10	29.92
Course 10	25.20	Course 10	44.49
Course 10	26.16	Course 10	55.42
Course 10	26.35	Course 10	57.58
Course 10	26.37	Course 10	110.64
Course 10	27.61	Course 10	123.01
Course 10	28.11	Course 10	128.29
Course 10	29.39	Course 10	139.03
Course 10	29.39	Course 10	208.02
Course 10	30.05	Course 10	224.16
Course 10	30.49	Course 10	224.37
Course 10	31.16	Course 10	227.51
Course 10	31.72	Course 10	238.64

Course 10	32.04	Course 10	249.36
Course 10	33.01	Course 10	264.12
Course 10	34.27	Course 10	266.76
Course 11	12.10	Course 11	39.72
Course 11	13.12	Course 11	39.72
Course 11	13.69	Course 11	50.67
Course 11	13.85	Course 11	53.91
Course 11	14.28	Course 11	54.62
Course 11	14.87	Course 11	61.63
Course 11	15.19	Course 11	61.63
Course 11	15.39	Course 11	62.58
Course 11	15.58	Course 11	78.90
Course 11	16.21	Course 11	78.90
Course 11	16.47	Course 11	81.11
Course 11	17.67	Course 11	110.27
Course 11	17.68	Course 11	111.40
Course 11	19.56	Course 11	127.34
Course 11	21.13	Course 11	131.68
Course 11	21.30	Course 11	137.67
Course 11	23.03	Course 11	141.25
Course 11	23.68	Course 11	141.88
Course 11	24.76	Course 11	142.51
Course 11	25.08	Course 11	144.11
Course 11	26.22	Course 11	144.27
Course 11	27.03	Course 11	150.67
Course 11	27.26	Course 11	153.91
Course 11	27.82	Course 11	154.59
Course 11	28.58	Course 11	154.62
Course 11	29.02	Course 11	157.21
Course 11	29.42	Course 11	168.41
Course 11	31.22	Course 11	181.11
Course 11	31.30	Course 11	194.97
Course 11	32.04	Course 11	210.37
Course 11	33.80	Course 11	218.31
Course 11	33.96	Course 11	222.82
Course 11	35.88	Course 11	224.95
Course 11	38.40	Course 11	227.36
Course 11	38.69	Course 11	232.61
Course 12	5.57	Course 12	24.61
Course 12	6.28	Course 12	26.52
Course 12	6.31	Course 12	29.31
Course 12	6.73	Course 12	29.94
Course 12	7.89	Course 12	32.15
Course 12	8.43	Course 12	33.67
Course 12	10.76	Course 12	35.05
Course 12	10.99	Course 12	37.15
Course 12	11.55	Course 12	37.44
Course 12	14.30	Course 12	41.22
Course 12	15.37	Course 12	41.33
Course 12	17.98	Course 12	43.51
Course 12	18.87	Course 12	45.14
Course 12	20.62	Course 12	48.25
Course 12	21.09	Course 12	48.41
Course 12	21.49	Course 12	49.13
Course 12	21.76	Course 12	49.15
Course 12	21.96	Course 12	49.24

Course 12	22.44	Course 12	52.33
Course 12	23.91	Course 12	55.57
Course 12	26.29	Course 12	57.53
Course 12	27.08	Course 12	58.33
Course 12	27.60	Course 12	58.80
Course 12	29.56	Course 12	61.99
Course 12	30.04	Course 12	62.00
Course 12	30.34	Course 12	64.22
Course 12	31.02	Course 12	68.75
Course 12	31.09	Course 12	71.01
Course 12	32.02	Course 12	74.54
Course 12	32.51	Course 12	77.06
Course 12	33.66	Course 12	80.19
Course 12	35.21	Course 12	81.51
Course 12	35.85	Course 12	86.84
Course 12	37.50	Course 12	112.73
Course 12	39.23	Course 12	121.92
Course 13	5.99	Course 13	36.68
Course 13	6.04	Course 13	39.16
Course 13	6.87	Course 13	39.19
Course 13	7.67	Course 13	39.26
Course 13	8.44	Course 13	40.12
Course 13	8.56	Course 13	41.29
Course 13	11.46	Course 13	42.49
Course 13	11.51	Course 13	43.17
Course 13	12.21	Course 13	45.81
Course 13	12.25	Course 13	49.94
Course 13	13.48	Course 13	50.91
Course 13	13.71	Course 13	52.99
Course 13	13.83	Course 13	56.64
Course 13	14.11	Course 13	58.64
Course 13	14.95	Course 13	64.99
Course 13	15.31	Course 13	65.12
Course 13	15.64	Course 13	67.72
Course 13	15.81	Course 13	75.02
Course 13	15.98	Course 13	84.12
Course 13	16.21	Course 13	84.30
Course 13	16.21	Course 13	85.55
Course 13	18.60	Course 13	93.58
Course 13	22.82	Course 13	94.00
Course 13	23.95	Course 13	103.08
Course 13	24.53	Course 13	104.78
Course 13	25.54	Course 13	110.25
Course 13	26.54	Course 13	111.08
Course 13	26.74	Course 13	111.12
Course 13	27.54	Course 13	117.52
Course 13	27.57	Course 13	117.88
Course 13	27.72	Course 13	131.94
Course 13	30.47	Course 13	154.60
Course 13	30.86	Course 13	221.74
Course 13	31.21	Course 13	236.74
Course 13	31.44	Course 13	252.87

APPENDIX G

Student Satisfaction

Table G

Student Satisfaction Data

SOS Text-Based Batch UID	Text-Based SOS	SOS IMBID Batch UID	IMBID SOS
Course 1	2.33	Course 1	2.78
Course 1	3.78	Course 1	3.33
Course 1	3.89	Course 1	5.00
Course 1	4.67	Course 1	4.11
Course 1	5.00	Course 1	3.11
Course 1	3.89	Course 1	4.00
Course 1	3.56	Course 1	4.00
Course 1	5.00	Course 1	2.89
Course 1	4.78	Course 1	5.00
Course 1	4.00	Course 1	2.78
Course 1	5.00	Course 1	2.89
Course 1	4.56	Course 1	4.89
Course 1	4.00	Course 1	5.00
Course 1	3.56	Course 1	3.11
Course 2	3.11	Course 1	4.56
Course 2	4.00	Course 1	5.00
Course 2	3.44	Course 1	3.89
Course 2	4.78	Course 1	4.22
Course 2	4.78	Course 2	5.00
Course 2	4.89	Course 2	5.00
Course 2	4.56	Course 2	5.00
Course 2	3.00	Course 2	4.67
Course 2	3.78	Course 2	5.00
Course 2	3.33	Course 2	5.00
Course 2	3.11	Course 2	4.00
Course 2	3.67	Course 2	4.00
Course 2	4.00	Course 2	5.00
Course 2	2.67	Course 2	3.78
Course 2	4.67	Course 2	5.00
Course 2	3.78	Course 2	3.56
Course 2	5.00	Course 2	5.00
Course 2	4.22	Course 2	4.00
Course 2	3.33	Course 2	4.44
Course 2	2.22	Course 2	5.00
Course 2	3.67	Course 2	5.00
Course 2	4.00	Course 2	5.00
Course 2	3.89	Course 2	3.89
Course 2	4.56	Course 2	5.00
Course 2	5.00	Course 2	4.33
Course 2	3.22	Course 2	4.22
Course 2	4.00	Course 2	5.00
Course 2	4.11	Course 2	3.89
Course 2	4.78	Course 2	4.11

Course 2	4.78	Course 2	3.89
Course 2	5.00	Course 2	4.78
Course 2	3.89	Course 2	5.00
Course 3	2.44	Course 2	5.00
Course 3	5.00	Course 2	4.00
Course 3	5.00	Course 2	4.00
Course 3	4.78	Course 2	4.00
Course 3	4.78	Course 2	5.00
Course 3	4.11	Course 2	4.67
Course 3	4.22	Course 2	5.00
Course 3	4.00	Course 3	4.00
Course 3	4.44	Course 3	5.00
Course 3	2.89	Course 3	5.00
Course 3	3.89	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	4.00	Course 3	5.00
Course 3	5.00	Course 3	4.78
Course 3	5.00	Course 3	5.00
Course 3	3.44	Course 3	5.00
Course 3	3.50	Course 3	5.00
Course 3	3.67	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	4.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	4.89	Course 3	5.00
Course 3	4.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 3	4.00	Course 3	5.00
Course 3	5.00	Course 3	5.00
Course 4	5.00	Course 3	4.00
Course 4	4.00	Course 3	5.00
Course 4	5.00	Course 3	5.00
Course 4	4.00	Course 3	5.00
Course 4	3.00	Course 3	4.00
Course 4	3.89	Course 3	5.00
Course 4	2.78	Course 3	5.00
Course 3	4.22	Course 4	4.00
Course 3	4.44	Course 4	5.00
Course 3	5.00	Course 4	5.00
Course 3	5.00	Course 4	5.00
Course 3	5.00	Course 4	4.00
Course 3	4.89	Course 4	5.00
Course 3	5.00	Course 4	4.00
Course 4	4.67	Course 5	4.67
Course 4	3.50	Course 5	4.00
Course 4	4.00	Course 5	4.00
Course 4	4.78	Course 5	4.89
Course 4	4.33	Course 5	5.00
Course 4	4.78	Course 5	5.00
Course 4	5.00	Course 5	4.89
Course 4	2.67	Course 5	5.00
Course 4	4.11	Course 5	4.67
Course 4	5.00	Course 5	4.44

Course 4	4.00	Course 5	5.00
Course 4	4.44	Course 5	4.67
Course 4	3.56	Course 5	4.00
Course 5	4.44	Course 5	4.22
Course 5	5.00	Course 5	4.00
Course 5	4.00	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 5	3.67	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 5	4.00	Course 5	4.11
Course 5	5.00	Course 5	5.00
Course 5	5.00	Course 5	4.00
Course 5	4.78	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 5	5.00	Course 5	5.00
Course 6	5.00	Course 5	5.00
Course 6	4.89	Course 5	3.44
Course 6	5.00	Course 5	5.00
Course 6	1.89	Course 6	5.00
Course 6	5.00	Course 6	5.00
Course 6	4.00	Course 6	5.00
Course 6	1.11	Course 6	5.00
Course 6	5.00	Course 6	4.11
Course 6	4.89	Course 6	4.89
Course 6	5.00	Course 6	4.67
Course 6	5.00	Course 6	5.00
Course 6	5.00	Course 6	5.00
Course 6	5.00	Course 6	5.00
Course 6	4.78	Course 6	5.00
Course 6	5.00	Course 6	5.00
Course 6	4.00	Course 6	5.00
Course 6	5.00	Course 6	4.89
Course 6	5.00	Course 7	5.00
Course 6	4.56	Course 7	4.33
Course 6	4.78	Course 7	5.00
Course 6	2.00	Course 7	4.00
Course 6	5.00	Course 7	5.00
Course 6	3.78	Course 7	5.00
Course 6	3.89	Course 7	5.00
Course 6	4.89	Course 7	5.00
Course 6	1.00	Course 7	5.00
Course 7	4.11	Course 7	3.11
Course 7	2.67	Course 7	3.89
Course 7	4.44	Course 7	5.00
Course 7	5.00	Course 7	3.00
Course 7	3.00	Course 7	4.67
Course 7	3.89	Course 7	5.00
Course 7	5.00	Course 8	5.00
Course 7	5.00	Course 8	4.67
Course 7	5.00	Course 8	4.78
Course 7	5.00	Course 8	3.78
Course 7	4.38	Course 9	3.00
Course 7	5.00	Course 9	5.00
Course 7	5.00	Course 9	3.33

Course 7	4.00
Course 7	4.00
Course 7	4.22
Course 7	4.78
Course 7	5.00
Course 7	4.11
Course 7	3.56
Course 7	5.00
Course 8	4.78
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Course 8	3.89
Course 8	4.22
Course 8	4.67
Course 8	1.00
Course 8	3.00
Course 8	5.00
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Course 8	5.00
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Course 8	1.00
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Course 8	4.78
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Course 8	5.00
Course 8	4.56
Course 8	3.67
Course 8	3.78
Course 8	5.00
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Course 8	3.89
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Course 11	4.78
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Course 11	2.78
Course 11	5.00
Course 11	5.00
Course 11	5.00
Course 12	4.00
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Course 12	5.00
Course 12	4.22
Course 12	4.67
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Course 12	4.22
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Course 12	3.33
Course 12	4.33
Course 12	4.22
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Course 12	5.00
Course 12	4.78
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Course 9	3.89
Course 9	4.78
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Course 9	5.00
Course 9	4.11
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Course 9	5.00
Course 9	3.33
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Course 9	4.78
Course 9	3.89
Course 10	4.78
Course 10	4.00
Course 10	4.11
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Course 10	2.89
Course 10	3.78
Course 10	3.33
Course 10	4.67
Course 10	4.00
Course 10	4.50
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Course 10	4.00
Course 10	5.00
Course 10	4.33
Course 10	4.44
Course 10	5.00
Course 11	3.67
Course 11	3.56
Course 11	5.00
Course 11	4.67
Course 11	2.78
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Course 11	4.78
Course 11	3.89
Course 12	4.00
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Course 13	1.00
Course 13	4.89
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Course 13	5.00

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Course 11	5.00
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Course 11	5.00
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Course 11	4.00
Course 11	4.33
Course 11	4.33
Course 11	4.44
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Course 11	1.00
Course 11	3.78
Course 12	4.11
Course 12	3.44
Course 12	4.00
Course 12	5.00
Course 12	4.44
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Course 13	5.00
Course 13	2.56

Course 13	3.78
Course 13	4.44
Course 13	4.89
Course 13	4.67
Course 13	5.00

APPENDIX H

Student Performance Zero Counts

Table H

Student Performance Zero Counts

	Text-Based			IMBID		
	Population N=	Zero Count	Percentage	Population N=	Zero Count	Percentage
Course 1	50	9	18%	50	0	0%
Course 2	105	28	27%	99	11	11%
Course 3	97	4	4%	89	3	3%
Course 4	47	0	0%	22	0	0%
Course 5	36	0	0%	62	1	2%
Course 6	63	1	2%	37	0	0%
Course 7	69	1	1%	42	0	0%
Course 8	102	10	10%	16	0	0%
Course 9	83	6	7%	33	0	0%
Course 10	75	5	7%	23	3	13%
Course 11	63	2	3%	68	0	0%
Course 12	53	1	2%	55	1	2%
Course 13	56	0	0%	75	0	0%
	899	67	6%	671	19	2%

APPENDIX I

Student Opinion Survey (SOS) Completion Rates

Table I

Student Opinion Survey Completion Rates

	Text-Based Population N=	Text-Based Sample N=	Text-Based Response Rate	IMBID Population N=	IMBID Sample N=	IMBID Response Rate
Course 1	50	14	28.0%	50	18	36.0%
Course 2	105	32	30.5%	99	35	35.4%
Course 3	97	36	37.1%	89	29	32.6%
Course 4	47	20	42.6%	22	7	31.8%
Course 5	36	14	38.9%	62	30	48.4%
Course 6	63	26	41.3%	37	14	37.8%
Course 7	69	21	30.4%	42	15	35.7%
Course 8	102	37	36.3%	16	4	25.0%
Course 9	83	24	28.9%	33	9	27.3%
Course 10	75	34	45.3%	23	10	43.5%
Course 11	63	27	42.9%	68	23	33.8%
Course 13	53	21	39.6%	55	31	56.4%
Course 14	56	22	39.3%	75	27	36.0%
	899	328	36.5%	671	252	37.6%

APPENDIX J

IRB Approval

MyBrandman <my@brandman.edu> Fri, Jun 14, 4:46 PM
to me, Douglas

Dear Andrea Munro,

Congratulations! Your IRB application to conduct research has been approved by the Brandman University Institutional Review Board. Please keep this email for your records, as it will need to be included in your research appendix.

If you need to modify your BUIRB application for any reason, please fill out the "Application Modification Form" before proceeding with your research. The Modification form can be found at IRB.Brandman.edu

Best wishes for a successful completion of your study.

Thank You,

BUIRB
Academic Affairs
Brandman University
16355 Laguna Canyon Road
Irvine, CA 92618
buirb@brandman.edu
www.brandman.edu
A Member of the Chapman University System

This email is an automated notification. If you have questions please email us at buirb@brandman.edu.

APPENDIX K

Organization Approval

From: "Bullock, Charles" <cbullock@brandman.edu>
Subject: RE: Request to use Brandman Student Data
Date: May 30, 2019 at 2:14:08 PM MST
To: "Devore, Douglas" <ddevore@brandman.edu>

Approved. Thank you.

From: Devore, Douglas <ddevore@brandman.edu>
Sent: Wednesday, May 29, 2019 12:59 PM
To: Bullock, Charles <cbullock@brandman.edu>
Subject: Re: Request to use Brandman Student Data

Hi Charles
Andrea has received the approval to use student data from both SAS and SOE. I have attached text email documents from both Deans. Please let me know if this is sufficient for her approval. If yes, then I will allow her to continue forward and apply to IRB.
Thanks for your support on this working through this request.
Doug
Doug DeVore, Ed.D.
Professor
Organizational Leadership
BUIRB Chair
ddevore@brandman.edu
www.brandman.edu
Contact Information:
T: 623.293.2421 | Fax: 623.218.9030
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