2014

Student engagement in an online course and its impact on student success

Angelique C. Hamane

Pepperdine University

Graduate School of Education and Psychology

STUDENT ENGAGEMENT IN AN ONLINE COURSE AND ITS IMPACT ON STUDENT SUCCESS

A dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Education in Educational Learning and Technology

by

Angelique C. Hamane

April, 2014

Farzin Madjidi, Ed.D. – Dissertation Chairperson

This dissertation, written by

Angelique C. Hamane

under the guidance of a faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

Doctoral Committee:

Farzin Madjidi, Ed.D., Chairperson

Paul Sparks, Ph.D.

José Luis Santos, Ph.D.

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ACKNOWLEDGEMENTS

Although this dissertation has my name as the sole author, there are many others who I would like to acknowledge because without them this work would not have been possible.

First and foremost, I'd like to thank God for the many blessings he has bestowed upon me, many of which are recognized below. Your everlasting love and presence that lies deep within me has guided me to where I am now. Thank you, Jesus!

I'd like to recognize Dr. Pedro Ramirez, professor at California State University, Los Angeles, mentor and friend. I am forever indebted to you for reading my many drafts as an undergraduate student, a master's student, and as a doctoral student. You mentored me on the "academic culture," encouraged me to pursue my doctoral degree, and listened to me when I needed someone to…well, just listen to me.

I am grateful for California State University's Chancellor's Doctoral Incentive Program for believing in my abilities as an instructor and my potential as a doctoral student and future CSU employee. Your generous financial support and travel grant has allowed me to study what I love and present my research at two international conferences.

I would also like to acknowledge the many scholars before me. Thank you Dr. Marcia Dixson from Indiana University-Purdue University for graciously allowing me to use your Online Student Engagement Survey. It was a big part of this dissertation. Many thanks to Dr. Ali Modarres, past Geoscience and Environment Department Chair and current University of Washington Director of Urban Studies, for giving me permission to study the online Natural Disasters course, and Dr. Michael Soldatenko, Professor at California State University, Los Angeles, for allowing me to study the online Race and Culture in Americas course. My deepest gratitude goes to Rebekka Helford, who provided valuable feedback during the early stages of

this dissertation when it was in its thinking stage, and again at its final stage. Your edits and feedback have not only made this a better manuscript but also made me a better writer.

I am indebted to the A-team. Amanda Schulze, thank you for being the OA in the cadre. All I had to do was just follow you to stay ahead in the game. Most importantly, thanks for being organized, staying on top of every thing, and picking up details that my brain always seemed to miss. Andrea Shea, thank you for being a worrywart. I never had to worry about anything because I knew you worried enough for the three of us. I always knew I wouldn't miss a deadline, forget to check in for a flight, or pay my tuition because you would bring it up way before it was due. I don't think I can thank the both of you enough for our weekly Skype sessions, our travels around the country, and our conference meetings. Last but not least, I would like to thank Vicky Kim, honorary A-team member. Your kind heart and love for numbers is infectious. You are my role model on how to be a nicer person.

I am sincerely grateful to my dissertation committee. Dr. Paul Sparks, thank you for introducing me to new media, teaching me about education policy, and advising me on building communities of practice. I'll never forget the "Magic Circle." Dr. José Luis Santos, thank you for your quick responses and willingness to jump in at the 11th hour so that I could complete my dissertation on time. You are truly a lifesaver. And, last but definitely not least, Dr. Farzin Madjidi, my dissertation chair. I believe that God has placed you in my life for the sole purpose of raising my mental, physical, and spiritual awareness to a whole different level. You have taught me to think like a statistician, act like a true leader, and live by the grace of God. You are, *** $p < .001$, highly significant.

I cannot go without showing my deepest gratitude to my family. I want to especially thank my in-laws, Kimio and Alice Hamane. You have always been there for the boys and me.

Whenever I had to do something for work, for school, or for fun, you were always there for them. I never had to worry. You two are a blessing.

I need to give a shout out to my three boys: Kory, Kyle, and Kole. What can I say? Your very existence is what drives me. Every decision I make and every action I do are done with you three in mind.

Most importantly, my deepest love and appreciation goes to my husband, Keith Hamane. I'm not sure what I did to deserve you, but I believe I hit the jackpot when I met you. You have given me the freedom to do what I want, when I want, and how I want to do it. You are always there for me and always made sure that I'm taken care of well. None of my accomplishments would have been possible without you. I am truly blessed.

VITA

EDUCATION

Pepperdine University, Doctor of Education in Learning Technologies, Ed.D., April 2014
California State University, Los Angeles, Geology, M.S., August 2005
California State University, Los Angeles, Child Development, B.A., June 1991

WORK HISTORY

Geology Instructor: California State University, Los Angeles (2005-present)

Taught face-to-face, hybrid, and online lower- and upper-division Geology, Natural Science, and First Year Seminar courses to a diverse student body. Designed curriculum and teaching material for lecture, lab, and activity. Created field guides for supervised field trips, mentored students in undergraduate research, developed rubrics for reports, and served on committees to improve student learning, and involved in research to stay current on best practices in the classroom.

Acting Associate Director of Academic Technology: California State University, Los Angeles (2011-2012)

Primary duties included planning and carrying out faculty development in instructional technology programs and activities, overseeing and managing CSULA's instructional technology staff; developing, collecting data to improve the quality of educational technology services and support; facilitating the transition of a campus-wide Learning Management System (LMS) from Blackboard to Moodle by taking the lead and overseeing Moodle pilot program; initiating, developing and implementing a web conferencing (Adobe Connect) pilot; standardizing a campus-wide clicker program.

Graduate Teacher Fellow: Eagle Rock High School, LAUSD (2003-2005)

Funded by the National Science Foundation's GK-12 program to build a working partnership between CSULA and area high schools to enhance science content in the classroom. Developed standards-based lesson plans, hands-on activities, and field-based experiences to improve student learning

Science Teacher: Woodrow Wilson High School, LAUSD (1993-1995)

Taught high school Biology and Physical Science, created lesson plans, managed class, maintained student records, participated in staff development

Science Teacher: Valle Lindo Continuation High School, EMUSD (1991-1993)

Instructed students in life science and physical science, maintained records, managed classroom for an alternative program for high school dropouts

SELECT COMMITTEE WORK/SPECIAL ASSIGNMENTS

Next Generation Science Standards/Course Redesign Faculty Learning Community (2013-2014) – This committee is currently working on redesigning the Natural Science courses (Geology, Astronomy, Biology, Chemistry, Physics, and Engineering) for elementary teachers by incorporating Crosscutting Concepts and NGSS Core concepts.

Inverting Large Lectures Faculty Learning Community (2012) – This committee discussed and implanted techniques to invert (flip) large lectures so that the majority of lecture time was provided online while valuable face-to-face time was used for active engagement.

Social and Academic Student Services (2011-present) – This committee serves to monitor CSULA's progress in improving retention and graduation rates to alleviate the financial burden on students by developing implementation plans for tactical steps, monitor progress on implementation and retention and graduation data.

Educational Effectiveness and Assessment Council (2011-2012) – As part of the retention and planning group, the EEAC promotes the understanding that student learning outcomes assessment and teaching and learning effectiveness relates to student achievement of learning outcomes; advise the campus on the educational effectiveness of the University in the development of a systematic long-term campus assessment program in alignment with the campus strategic plan.

Moodle (2011-present) – Common Interest Group (CIG), Strategies and Priorities Group (S&PG), and the Quality Online Learning and Teaching (QOLT) subcommittees work in collaboration with other CSU campuses on Moodle issues, best practices, and support.

Natural Science Adviser (2007-2008)– Help students clearly define educational and career goals, evaluate student transcripts, advise students on course requirements toward graduation, help students become familiar with policies and regulations that may affect their degree objective, assist students in possible scholarship and/or internship programs, initiate continued adviser relationship with students.

Natural Science Committee Member (2008)– Assist in development of 2- and 4-year plans for new and transferring students in the Natural Science program, curriculum development.

California Teaching Credential Committee (2008)– Charged with the task of evaluating CSULA's geoscience curriculum to ensure the program meets California state standards for the Natural Science program's education preparation and accreditation.

ABSTRACT

While much has been written about student engagement and its linkage to positive student outcomes—such as higher-order thinking, improved grades, and increased retention and graduation rates in traditional settings—little, if any, research has been done to connect student engagement and online student success. Learning Management Systems (LMSs) have the ability to measure student engagement by tracking frequency of logins, frequency of page visits, and frequency of discussion forum views, posts, and replies. Equally important, students who are aware of their levels of engagement compared to those levels measured by an LMS can self-monitor their progress and prevent the likelihood of failing a course. This initial exploratory study sought to determine whether relationships exist between students' perceived level of engagement and students' actual level of engagement as measured by an LMS, students' perceived level of engagement and student success, and students' actual level of engagement as measured by an LMS and student success. Correlation and regression analyses were performed to determine type and strength of relationships. Non-probability purposive sampling was used to recruit 38 respondents. Data showed that meaningful findings, which yielded statistically significant, modest or moderate positive partial relationships, occurred in the discussion forums. There were moderate positive relationships between students' perceived level of engagement and frequency of discussion forum posts and replies, students' perceived level of total engagement and student success, and students' frequency of discussion forum views, posts, and replies, and student success. This initial exploratory study is useful in helping to refine future studies and learning more about student engagement levels in an online course and its relationship to positive student outcomes. Results can potentially help administrators and educators in making data-based decisions, and help students self-monitor engagement levels to improve student learning.

Chapter 1: Introduction

Introduction to the Problem

The American dream is to have a better life: professional success, financial security, and personal happiness. There is perhaps no better way to achieve the American dream than to succeed in college. Student success has traditionally been measured by earning a college degree. Possessing a baccalaureate degree has been linked to higher salaries, improved health, and increased involvement in civic engagement.

It has been well established that adults who hold a bachelor's degree have substantially better prospects in the labor market than those who only hold a high school diploma. According to the National Center for Education Statistics (NCES, 2009), young adults whose ages range from 25-34 years old with a bachelor's degree have starting median salaries of $45,000, while young adults with only a high school diploma have starting median salaries of $29,000. In other words, young adults with a bachelor's degree earn approximately 50% more than young adults with only a high school diploma or equivalent. These statistics are stable for male, female, White, Black, Hispanic and Asian subgroups. Brock (2010) adds that adults with a bachelor's degree earn twice as much, or roughly $2.1 million more, in their lifetime than someone who only holds a high diploma.

In addition to higher salaries, a person who possesses a bachelor's degree has been shown to have better health and longer life expectancy. Studies have shown a significant negative correlation between higher levels of education and heart disease, high blood pressure, diabetes, and other preventable diseases (Brock, 2010; Cutler & Lleras-Muney, 2010; Fletcher & Frisvold, 2009). Better-educated people engage in more preventative behaviors when it comes to their health; they often receive physical examinations, dental examinations, flu shots, vaccines, and

cholesterol tests (Fletcher & Frisvold, 2009). In addition, Cutler and Lleras-Muney (2010) state that college educated patients who have an ailment, such as hypertension or diabetes, are more likely followed by a physician who can counsel them on additional preventative measures and healthy lifestyle changes. Cutler and Lleras-Muney believe that improved health may be due to the fact that people who are better educated have higher cognition levels in terms of their wellbeing.

Higher earnings and better health are positively related to longer life expectancy (Cristia, 2009; Meara, Richards, & Cutler, 2008). Cristia (2009) studied administrative and survey data from 1983 to 2003 and found an inverse relationship between a person's lifetime earnings and mortality rate. In other words, the more a person earns in his/her lifetime, the less likely it is that he/she will die within a stated time period. A study performed by Meara et al. (2008) demonstrated that individuals with more than 12 years of education had significantly longer life expectancies compared to those who did not continue their education beyond high school. As of the year 2000, an average college graduate at age 25 could expect to live to age 82, while a non-college graduate at age 25 could expect to live to age 75. These findings are true for every demographic group and in every country (Cristia, 2009).

Not only do adults reap personal benefits from obtaining a higher degree, but also society as a whole benefits as well. Educated citizens are capable of evaluating complex social, economical, and political issues; therefore, they are more likely to engage in civic activities (Dee, 2004). For example, citizens with higher levels of educational attainment are more likely to vote (Brock, 2010; Dee, 2004). More schooling is also related to higher levels of volunteerism and social activism.

(2000) asserts that a person's level of education is the most consistent predictor for volunteering because "it heightens awareness of problems, increases empathy, and builds self-confidence" (p. 219). Educated citizens are also more likely to support controversial free speech and have a higher newspaper readership.

It is well known that the benefits of obtaining a college degree are explained by the knowledge, skills, and friendships students acquire while enrolled in college (Brock, 2010). For this reason, more students are seeking a college degree. There has been a steady rise in college enrollments since the 1960s. Higher education institutions have seen a nearly 300% increase in total enrollments, with 5.9 million students enrolled in 1965 to approximately 17.5 million students enrolled in 2005. Changes in public attitudes and federal policies have not only helped to increase enrollments, but also opened access to higher education for women, minority, and nontraditional students (Brock, 2010; Karen, 1991). Passage of federal policies, such as the 1960 Civil Rights Act, broadened access to underrepresented groups, and the 1965 Higher Education Act widened access to economically disadvantaged students by offering need-based financial aid to the general public (Brock, 2010).

Changes in social attitudes and implementation of federal policies have opened access to higher education to the general public, transforming the characteristics of a typical college student. Brock (2010) outlines a number of changes to student demographics in higher education. In the 1970s, colleges and universities enrolled more male students than female students. By 2005, the gender ratio had reversed, resulting in colleges and universities enrolling more female students than male students. Ethnic minority groups have nearly doubled since the 1970s, with the largest increases in Asian and Hispanics enrollments. Brock also states that the traditional full-time student who entered college immediately after high school graduation and who relied

on parents for financial support are now the exception rather than the rule. College students are more likely to be in their 20s or older and work while going to school. Higher education institutions have also augmented course delivery modes with online programs to meet the changing characteristics of a typical college student to a more diverse student population.

Brock (2010) argues that nontraditional students are more likely to participate in distance education. For the past 10 years, the number of college students who enroll in online courses has steadily increased. According to Allen and Seaman (2011), "online enrollments have been growing substantially faster than overall higher education enrollments" (p. 4). At the time of this writing, approximately 6.7 million students—32% of all higher education students—had taken at least one online class (Allen & Seaman, 2013). The availability of the Internet and the use of the World Wide Web to disseminate and share information have been the primary reasons for this increase (Moore & Kearsley, 2012). California State University (CSU) has recently initiated a new online program, *CSU Online*, to increase access for nontraditional working professionals and to meet California's economic needs (Morales, 2012).

CSU is the largest public school system in the United States, comprising 23 campuses throughout California, enrolling almost 437,000 students, and employing approximately 44,000 faculty and staff (California State University, 2013). In 2010, CSU announced its new CSU Online Initiative to be launched in the spring of 2013. Morales (2012) recently affirmed that CSU Online will offer completely online programs to provide people who work or have family obligations the opportunity to attend college even when they physically cannot make it on to a campus. Kolowich (2012) relayed CSU's goal "to enroll over 250,000 students over the next several decades" (para. 3), supporting online growth for years to come.

Although access to a college education has increased over the last 40 years, "student success—as measured by persistence and degree attainment—has not improved at all" (Brock, 2010, p. 109). Persistence, also termed *retention rate*, measures the percentage of first-time, full-time college freshmen returning for their second year at a 4-year college. In 2009, the National Center for Higher Education Management System (NCHEMS, 2009) stated that 77.1% of first-time, full-time college freshman persisted into their second year of college. Retention rates for the 10 largest online institutions were much lower at 55%. Graduation rates measure the number of first-time, full-time students who complete their bachelor's degree at the same institution within 6 years or 150% of normal completion time to degree (Aud, Hussar, Johnson, Kena, and Roth, 2012). According to the NCHEMS (2009), the average graduation rate for first-time, full-time students after 6 years in the United States was 55.5%. Aud et al. (2012) contend that completion rates for bachelor's degree varies by institution; private, nonprofit institutions have the highest graduation rates at 65%, followed by public, nonprofit institutions at 56%, and private for-profit institutions, which include large online institutions, have the lowest graduation rates at 28%.

Recent attention has been given to the lack of degree attainment over time, even though access and enrollments have steadily increased (Cruz & Haycock, 2012). In an open letter to the National Association of Independent Colleges and Universities, a group of college presidents from a variety of higher education sectors—2-year and 4-year public and private nonprofit institutions—urged individual institutions to do more to improve college completion rates (Nelson, 2013). The college presidents urged leaders that strategies to improve college completion rates should be the nation's top priority. Brock (2010) agreed that higher education institutions "need to do much more to promote student success" (p. 109).

Universities and colleges have traditionally used various tools, such as standardized tests and grades, to measure a student's academic success. Standardized tests have been commonly used to predict a student's future academic performance in undergraduate institutions (Popham, 1999). Most high school seniors complete the Scholastic Aptitude Test (SAT) each year to measure their performance in critical reading, math, and writing. The American College Test (ACT) is another standardized test administered to high school students to measure levels of proficiency in four academic areas of English, mathematics, reading, and science. College students must take the Graduate Record Exam (GRE) and Miller Analogies Test (MAT) to gain admittance to graduate schools in the United States (Brown et al., 2008). These tests measure a student's level of verbal reasoning, analytic writing, and critical thinking skills. Grades, in contrast, are a form of assessment that measures a student's past performance in a course. Multiple grades are averaged by unit weight to determine a student's Grade Point Average (GPA) and provide a glimpse of a student's past performance in school.

Traditional measures using standardized tests to predict a student's future success and grades to measure a student's past performance are commonly used in the higher education sector. Nontraditional measures, such as student engagement, have not been realized for their ability to measure a student's real-time academic performance. Student engagement has been defined as the amount of time and effort a student puts forth into educational activities (Astin, 1984; Kuh, 2004; Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008; Skinner & Belmont, 1993). Empirical studies have linked student engagement to various measures of student achievement. Research has shown that student engagement has been related positively to desirable learning outcomes, such as higher-order thinking, improved grades, and increased student persistence and college completion rates (Astin, 1984; Carini, Kuh, & Klein, 2006; Junco, 2012).

Purpose of Study

Administrators and faculty have long understood the importance of student engagement and its relationship to student success. Engagement is measured by the amount of time and effort a student spends on academically purposeful activities, such as studying course content, participating in class discussions, and interacting with faculty and peers. Learning Management Systems (LMSs) are capable of measuring engagement by recording the frequency of student logins and the number of various page visits. Student interactions are also documented by logging the number of participant views, posts, and replies to discussion forums. Equally important are students' perception and awareness of their level of engagement in a course. Students who understand their level of engagement compared to levels measured by the LMS can monitor their progress and prevent the likelihood of failing a course. Accordingly, the purpose of this initial exploratory study was to determine whether relationships exist between students' perceived level of engagement in an online course and students' actual level of engagement as measured by the LMS, and students' perceived and actual levels of engagement and student success.

Research Questions

The following research questions informed the study:

Research Question #1: What is the relationship between students' perceived level of engagement and students' actual level of engagement as measured by an LMS?

Research Sub-question #1a: What is the relationship between students' perceived level of engagement and frequency of student logins in an LMS?

Research Sub-question #1b: What is the relationship between students' perceived level of engagement and frequency of page visits in an LMS?

Research Sub-question #1c: What is the relationship between students' perceived level of engagement and frequency of discussion forum views?

Research Sub-question #1d: What is the relationship between students' perceived level of engagement and frequency of original discussion forum posts?

Research Sub-question #1e: What is the relationship between students' perceived level of engagement and frequency of discussion forum replies?

Research Question #2: What is the relationship between students' perceived level of engagement and student success?

Research Question #3: What is the relationship between students' actual level of engagement as measured by an LMS and students' success in an online course?

Research Sub-question #3a: What is the relationship between students' frequency of student logins on an LMS and students' success?

Research Sub-question #3b: What is the relationship between students' frequency of page visits on an LMS and students' success?

Research Sub-question #3c: What is the relationship between students' frequency of discussion forum views and students' success?

Research Sub-question #3d: What is the relationship between students' frequency of original discussion forum posts and students' success?

Research Sub-question #3e: What is the relationship between students' frequency of discussion forum replies and students' success?

Significance of the Study

This study will help administrators, educators and students to identify LMS data that measure student engagement. Beer, Clark, and Jones (2010) claim that identifying early

indicators of student engagement will give institutions the ability to measure factors that can inform and improve current teaching practices, thus increasing retention and graduation rates. The process of extracting, analyzing, and interpreting data to gain insights into student learning has been termed *learning analytics* (Bienkowski, Feng, & Means, 2012). Administrators who initiate the use of analytics at their institutions can develop new or refine existing policies that support Information Technology Services (ITS) implementation and faculty development in analytics. Harvesting real-time student data will also help educators track student progress to determine whether students are at risk of failure and if teaching practices need to be adapted to promote student engagement. Students will also be interested in how analytics impact their final grade (Campbell, DeBlois, & Oblinger, 2007). By understanding their online behavior and its relationship to success or failure of a course, students can self-monitor their progress from data provided by LMSs. Results from this study will help fill the research gap in understanding relationships between students' perceived level of engagement and students' actual levels of engagement as measured by an LMS data, students' perceived level of engagement and student success, and students' actual level of engagement and student success. This study will offer educators an early warning system to identify students who are at risk of failure based on real-time data, enabling them to quickly adapt teaching methods to engage students in the learning process.

Key Definitions

Graduation rates: calculated as the actual number of first-time, full-time undergraduate students who completed a bachelor's degree within 150% of normal time to degree attainment (or 6 years) divided by the total number of first-time, full-time students who began their academic career the same year (National Center for Educational Statistics, 2012).

Educational Data Mining: a technique that collects and analyzes student data to discover new patterns from data and to develop predictive models or algorithms to predict an outcome (Bienkowski et al., 2012).

Learning analytics: the process of using known methods to collect and analyze student data in order to answer important questions about student learning. A key application of learning analytics is to monitor a student's performance to predict potential issues so that early interventions can take place (Johnson, Smith, Willis, Levine, & Haywood, 2011).

Learning Management System (LMS): a software system that processes, stores, and disseminates academic course material, and offers management and communication features to support teaching and learning (McGill & Klobas, 2009).

Online Education: distance learning as education for which the instructor and students are located at different places while teaching and learning for the majority of the time (Moore & Kearsley, 2012). More specifically, courses in which at least 80% of the course content is delivered online (Allen & Seaman, 2013)

Retention rate: the percentage of freshmen that re-enroll the following academic year as sophomores (Arnold, 1999).

Student engagement: the amount of time and energy a student invests in educationally purposeful activities and the effort institutions devote to using effective educational practices (Kuh, 2001).

Operational Definitions

Frequency of logins: the total number of times a student logs into the online LMS without logging off of the system for one course term.

Frequency of discussion forum posts: the total number of original posts a student makes to a discussion forum. Posts may be made under the same topic or under a different topic, so long as it begins a new threaded discussion with a new topic for discussion for that student. Responses to previously posted threads or replies do not count as posts.

Frequency of discussion forum replies: the total number of times a student replies to a discussion forum. Replies may be to another student's original post, a follow-up response to a previously posed question, or a response to another person's reply that continues the same topic of discussion. It does not begin a new threaded discussion or a new topic for discussion.

Frequency of discussion forum views: the total number of times a student visits a discussion forum but does not contribute to the postings. Each visit is counted when a student leaves the page and returns whether during the same log in or subsequent log ins.

Frequency of page visits: the total number various pages a student visits while logged on to the system for the duration of the course term.

Perceived level of engagement: measures a student's response to the Online Student Engagement Survey (OSES) created, validated, and used with permission by Marcia Dixson (2010). A 19-item questionnaire based on a student's level of engagement in four subcategories: skills engagement, emotional engagement, participation engagement, and performance engagement. Student responses range from 0 (not at all characteristic of me) to 4 (very characteristic of me) yielding a total score of 0-76. Total scores for the four subcategories include the following; skills engagement contains six items resulting in a score of 0-24, emotional engagement contains five items resulting in a score of 0-20, participation engagement contains six items resulting in a score of 0-24, and performance engagement contains two items resulting in a score of 0-8.

Student success: measures a student's achievement of course objectives by calculating a student's final percentage by dividing total points earned by total points possible and multiplying the quotient by 100.

Assumptions and Limitations

This study was bounded by the following assumptions and limitations. It was assumed that all students who enrolled in an online course had moderate proficiency in technology usage. Students were assumed to be able to upload files, create new discussion forum posts and reply to peers' posts, read and reply to online messages, and navigate the online site without difficulty. It was assumed that all students who participated in the study and filled out the OSES understood all survey questions and answered each question honestly. It was also assumed that the online course design was not a significant factor affecting a student's level of engagement.

This research was limited due to the sample and sample size. The sample was non-random in that students were assumed to have a basic comfort level with technology, therefore enrolling in a completely online course. Convenience sampling limited the sample, which, as a result, was not representative of the entire CSU, Los Angeles (CSULA) undergraduate population. Therefore, generalizability and inferences to larger populations are limited and should be done with caution.

Organization of the Study

This initial exploratory study applied learning analytics to determine whether relationships exist between students' perceived level of engagement and students' actual level of engagement as measured by an LMS, students' perceived level of engagement and student success, and students' actual level of engagement and student success. This research study is organized into 5 chapters. Chapter 1 provides the introduction to the proposed study by

describing the background of the problem, purpose statement, research questions, rationale and significance of the proposed study, and key definitions. Chapter 2 reviews the literature on student engagement and its relationship to student outcomes as defined by higher levels of critical thinking, improved grades, and increased retention rates. The literature review also addresses student engagement in online education, LMSs, and more specifically discussion forums and how student behavior can be tracked through data mining, academic analytics and learning analytics processes. Chapter 3 describes the proposed methodology of the study including research design, population and sample, proposed data collection procedures, and methods for analysis. Chapter 4 reports the research findings. Lastly, Chapter 5 summarizes the results, presents the findings and conclusions, and makes recommendations for future research.

Chapter Summary

Chasing the American Dream to obtain professional success, financial security, and personal happiness via a higher education degree has led to a steady increase in college enrollments since the 1960s. Public attitudes and federal policies have helped to widen access to higher education to include women, minorities, and nontraditional students. Online education enrollments have also increased, providing opportunities for more diverse student populations. Although traditional and online education enrollments have increased over the years, the number of students obtaining their college degree has not. A group of college presidents from a variety of higher education sectors put a call out to higher education leaders to do more to ensure that students complete their college degree. Traditional measures of student success have been used to either predict future performance or assess past academic achievements, but have failed to give real-time measures of student progress. Measuring student engagement can help educators track student progress in real time to determine whether a student is at risk of failing a course and

whether teaching practices need to be modified. This initial exploratory study sought to determine whether relationships exist between students' perceived level of engagement and students' actual level of engagement, students' perceived level of engagement and students success, and students' actual level of engagement and student success. Empirical studies have shown that student engagement is a key contributing factor to student success. Results from this study will contribute to the gap in the literature on how extracted data can be used to analyze and determine whether students' engagement levels are related to student learning, which ultimately leads to student success.

Chapter 2: Literature Review

Overview

In order to better understand how data extracted and analyzed from an LMS can be used as early indicators for student engagement, relevant literature will be reviewed. An overview of the research on student engagement is presented, including its positive relationships to students' higher-order thinking, improved grades, student retention, and ultimately college completion. This study also explores the continuous growth of online education and elucidates the role of LMSs in delivering online content and their various uses in promoting student engagement. The evolution of analytics in higher education is also examined, including differentiating commonly used terms (i.e., education data mining, academic analytics and learning analytics) and describing efforts using the various forms of analytics to measure student engagement.

Theoretical Framework: Student Engagement

Student engagement has been studied extensively for the past 40 years and has been used to describe a variety of student behaviors. Hu and Kuh (2002) assert that student engagement is "the most important factor in student learning and personal development during college" (p. 555). Many researchers have offered various meanings of engagement, starting with Astin's (1984) definition of student involvement as the degree to which students are involved in school-related matters by "the investments of physical and psychological energy in various objects" (p. 519). Skinner and Belmont (1993) describe engagement as the intensity and quality of behavioral and emotional involvement during learning activities. According to Kuh (2001, 2004, 2009), engagement is the amount of time and effort students invest in academic activities related to student learning outcomes. As evidenced in the literature, many researchers agree that student engagement reflects the amount of time and effort a student puts forth into educational activities

and is directly related to a variety of desired student outcomes (Astin, 1984; Kuh, 2004; Kuh et al., 2008; Skinner & Belmont, 1993). In essence, the more time and energy a student spends participating in meaningful activities, the more engaged he/she is in his/her education.

Empirical Research on Student Engagement

Education researchers have studied student engagement widely for decades and commonly accept its positive relationship to student achievement. As cited in Kuh (2009), a brief history has been provided summarizing the foundation of student engagement as follows:

- Time on Task (Tyler, 1930s)
- Quality of Effort (Pace, 1960-1970s)
- Student Involvement (Astin, 1984)
- Social, Academic Integration (Tinto, 1987, 2005)
- Good Practices in Undergraduate Education (Chickering & Gamson, 1987)
- Student Engagement (Kuh, 1991)

The earliest research focused on student engagement within the classroom. For example, in the 1930s, Ralph Tyler's *Time on Task* studied the amount of time a student spent on education-related activities in the classroom (as cited in Kuh, 2009). Later studies, such as Pace's *Quality of Effort,* studied students' effort inside and outside of the classroom. Over the years and many researchers later, empirical research on student engagement branched out into multidimensional constructs categorizing student engagement into three distinct areas: behavioral, cognitive, and emotional. Further studies documented the direct correlation between student engagement and various positive student outcomes, such as improved learning, higher grades, and increased retention.

Early studies on student engagement. One of the earliest pioneers of student engagement was Ralph Tyler, an educational psychologist, who demonstrated the positive effects of *time on task* on student learning (Tyler, as cited in Kuh, 2009). In the 1960s and 1970s, Pace and Kuh (1998) developed the College Student Experience Questionnaire (CSEQ), which asked students about their educational experiences both inside and outside of the classroom. Results of the survey compared students to their peers in four major areas: learning activities, practices that promote better learning, opinions of the campus environment, and making progress. The researchers posited that learning requires time and effort not just in in-classroom activities, but in out-of-classroom activities as well, such as involvement in clubs and organizations, music and art events, and going to the library, to name a few. Practices that promote learning and development involve spending more time studying, interacting with professors, and engaging with other students from diverse backgrounds. In addition, how students felt about the campus environment—whether the campus developed scholarly and intellectual curiosities, provided career-related experiences, and fostered positive faculty, staff, and student relationships—was equally important in fostering learning and development.

Astin (1984) continued research on the quality of effort with his theory on Student Involvement, which not only describes a student's involvement but also how institutions need to be involved. His model defined student involvement as "the amount of physical and psychological energy that a student devotes to academic experiences" (p. 518). Astin proposed the following five tenets of student involvement:

1. Involvement refers to the investment of physical and psychological energy in various objects. The objects may be highly generalized (the student experience) or highly specific (preparing for a chemistry examination)

2. Regardless of its object, involvement occurs along a continuum; that is, different students manifest degrees of involvement in a given object, and the same student manifests different degrees of involvement in different objects at different times.
3. Involvement has both quantitative and qualitative features. The extent of a student's involvement in academic work, for instance can be measured quantitatively (how many hours the student spends studying) and qualitatively (whether the student reviews or comprehends reading assignments or simply stares at the textbook and daydreams).
4. The amount of student learning and personal development associated with any educational program is directly proportional to the quality and quantity of student involvement in that program.
5. The effectiveness of any educational policy or practice is directly related to the capacity of that policy or practice to increase student involvement. (p. 519)

The first three principles of Astin's (1984) theory assert that the more involved a student is in college, the more learning a student experiences. The last two principles involve institutional policies and the degree to which programs increase or decrease student involvement in both academic and non-academic activities. Astin's early work emphasized the importance of student involvement and its relationship to student achievement.

Since then, researchers such as Vincent Tinto (1987, 1997) and Arthur Chickering and Zelda Gamson (1987) have authored numerous research papers addressing different aspects of student engagement and its relationship to student outcomes. Tinto's studies on retention identified three major reasons why students drop out of higher education: academic difficulties, inability to align career and educational goals, and failure to immerse themselves in the social

and intellectual life of the institution. Chickering and Gamson's seven principles of good practice in undergraduate education include:

1. Student-faculty contact,
2. Active learning,
3. Prompt feedback,
4. Time on task,
5. High expectations,
6. Experience with diversity, and
7. Cooperation among students.

Chickering and Gamson argue that these principles describe various aspects of student engagement and act as guidelines for administrators, faculty, and students to follow to improve undergraduate education.

In Pascarella's (2006) "How College Affects Students," the researcher claims that individual effort and involvement are critical factors that determine a student's success, and institutions need to find ways to focus their academic and extracurricular activities to encourage student engagement. In other words, to improve student engagement, students need to devote time and energy toward purposeful educational activities, and institutions need to use effective educational practices to induce students to get involved in educationally purposeful activities. Effective higher education institutions engage students by guiding their energy toward the right activities.

Student engagement as a multidimensional construct. More recent empirical research recognizes student engagement as a multidimensional construct, involving behavioral, cognitive, and emotional components (Fredricks, Blumenfeld, & Paris, 2004; Kuh, Kinzie, Buckley,

Bridges, & Hayek, 2006; Skinner & Belmont, 1993). Behavioral engagement refers to what an individual does. Fredricks et al. (2004) describe behavioral engagement as "the idea of participation; it includes involvement in academic and social or extracurricular activities" (p. 60) that contribute to students' academic success. Cognitive engagement refers to what an individual thinks. Skinner and Belmont (1993) define cognitive engagement as the level of thinking students use to understand complex ideas and master challenging skills. Emotional engagement refers to how an individual feels. Fredricks et al. describe emotional engagement as the positive and negative reactions a student feels towards teachers, peers, coursework, and school. Emotional engagement facilitates the creation of bonds to the institution and promotes a willingness to do the required work to be successful in school.

Student Engagement and Its Relationship to Student Performance

Student engagement is positively related to a wide range of desired student performances, such as higher cognitive thinking, improved grades, and increased retention rates (Astin, 1984; Carini et al., 2006; Junco, 2012; Kuh, 2004; Kuh et al., 2006, 2008; Skinner & Belmont, 1993). Higher-order thinking—originally defined by Bloom, Engelhart, Furst, Hill, and Krathwohl in 1956 and later modified by Anderson and Krathwohl in 2002—is an organized framework describing a learning process where students aim to perform at the highest cognitive levels by analyzing, evaluating, and creating (as cited in Forehand, 2010). Students who think at higher cognitive levels earn higher grades (Carini et al., 2006). In education, grades have traditionally been used as a form of summative assessment where students are measured against some standard to determine their achievements (Cross & Angelo, 1988). Additional studies have shown that students with higher grades are more likely to persist and complete college (Kuh et al., 2006; Tinto, 1997). It has been well documented that the more time and effort students spend

in educationally purposeful tasks, thinking about complex ideas, and interacting with peers and faculty members, the more likely they are to persist in school and complete their degrees (Astin, 1984; Carini et al., 2006; Finn & Rock, 1997; Junco, 2012).

Impact of student engagement on higher-order thinking. Higher-order thinking is best described using Bloom's Taxonomy: a hierarchical model classifying levels of thinking based on six categories ranging from low, simple cognitive thinking to high, complex cognitive thinking. The six cognitive levels—*knowledge*, *comprehension*, *application*, *analysis*, *synthesis* and *evaluation*—are ordered from simple to complex and are hierarchically cumulative (Bloom et al., as cited in Krathwohl, 2002). Knowledge, comprehension, and application are characterized as low-order, simple cognitive thinking levels. These levels include activities where students are required to understand material, memorize content, and relate material to various learning situations (Forehand, 2010). Lower-ordered cognitive thinking needs to be mastered before moving on to higher-ordered cognitive thinking levels (Krathwohl, 2002). Students who have mastered the analysis level have also mastered the knowledge, comprehension, and application levels as well. Analysis, synthesis, and evaluation are characterized as higher-order, complex cognitive thinking levels (Forehand, 2010). It is believed that higher-order cognitive thinking requires more mental processes in exploring and creating new knowledge.

During the 1990s, revisions to Bloom's taxonomy were completed by one of Bloom's former students, Lorin Anderson, and expounded upon in Anderson and Krathwohl's (2001) "Theory into Practice" (Forehand, 2010; Krathwohl, 2002). The updated version of Bloom's taxonomy included small but significant changes in the terminology to reflect 21st century students and teachers (Forehand, 2010). Bloom's six major categories were changed from nouns to verbs and renaming 3 of the 6 categories (see Figure 1). The lowest cognitive levels,

knowledge and *comprehension*, were renamed *remembering* and *understanding*, and the highest cognitive level, *synthesis,* was renamed *creating* and repositioned to the highest level.

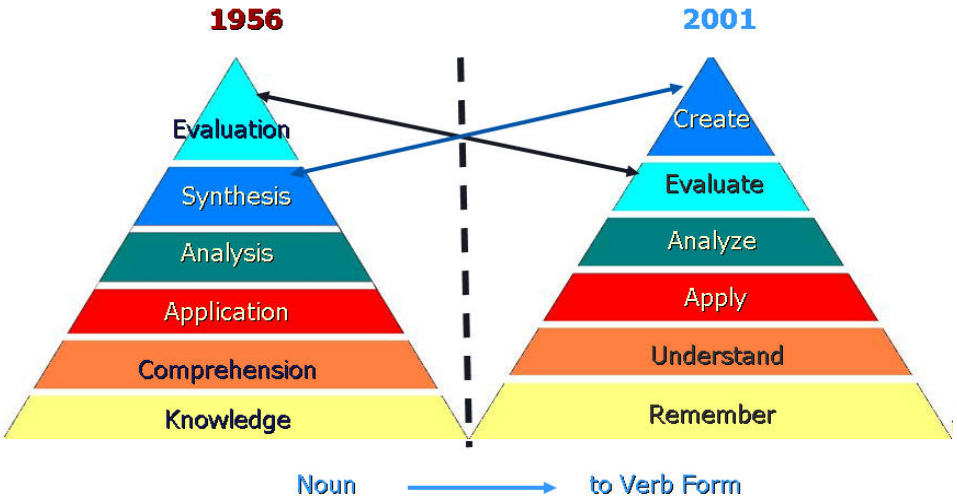

Figure 1. Visual representation of the two comparisons of Bloom's Taxonomy. Reprinted from *Beyond Bloom - A New Version of the Cognitive Taxonomy*, by L. O. Wilson, 2006. Retrieved from http://www4.uwsp.edu/education/lwilson/curric/newtaxonomy.htm. Copyright 2006 by Lisa Owen Wilson. Reprinted with permission.

Anderson, Krathwohl, and Bloom (2005) also included structural changes to Bloom's taxonomy by adding another dimension: Knowledge. Bloom's Cognitive Process Dimension represents the original cognitive levels and describes the *process used* to learn. The new Knowledge Dimension describes the *kinds of knowledge* to be learned (Forehand, 2010). Whereas the Cognitive Process Dimension maintains the six cognitive categories of remembering, understanding, applying, analyzing, evaluating, and creating, the Knowledge Dimension subdivides knowledge into factual knowledge, conceptual knowledge, procedural knowledge, and meta-cognitive knowledge. The structural changes are depicted in Table 1, showing progressing constructs of the Cognitive Process Dimension moving from left to right across the columns and progressing constructs of the Knowledge Dimension moving from top to bottom rows. Each dimension is ordered from simple to complex, or concrete to abstract, in columns moving from left to right and in rows moving from top to bottom (Krathwohl, 2002).

Table 1

Bloom's Updated Two-dimensional Taxonomy Table

		Cognitive Process Dimension					
		Remember	Understand	Apply	Analyze	Evaluate	Create
Knowledge Dimension	Factual Knowledge	List	Summary	Classify	Order	Rank	Combine
	Conceptual Knowledge	Describe	Interpret	Experiment	Explain	Assess	Plan
	Procedural Knowledge	Tabulate	Predict	Calculate	Differentiate	Conclude	Compose
	Meta Cognitive Knowledge	Appropriate Use	Execute	Construct	Achieve	Action	Actualize

Note. Reprinted from *Beyond Bloom - A New Version of the Cognitive Taxonomy*, by L. O. Wilson, 2006. Retrieved from http://www4.uwsp.edu/education/lwilson/curric /newtaxonomy.htm. Copyright 2006 by Lisa Owen Wilson. Reprinted with permission.

Most of the empirical studies on student engagement have been concerned with increasing student learning. Coates, James, and Baldwin (2005) state, "Student engagement is concerned with the extent to which students are engaging in a range of educational activities that research has shown as likely to lead to high quality learning" (p. 26). Floyd, Harrington, and Santiago (2009) later confirmed Coates et al.'s affirmation that higher-order thinking is a result of high levels of student engagement. Subsequent studies have shown that high levels of engagement in educational experiences yield higher levels of critical thinking, reasoning, and cognitive growth. In "Student Engagement and Student Learning: Testing the Linkages" by Carini et al. (2006), the researchers sampled 1,058 undergraduate students at 14 four-year higher education institutions and found that many student engagement measures were linked to improved critical thinking. Carini et al.'s study confirmed the findings of Kuh's (2003) previous work documenting that the more students study or practice a subject, the more adept they become in that subject.

In more recent studies, however, researchers have explored various teaching techniques to determine which method enhances student engagement to improve cognitive thinking. For example, Saadé, Morin, and Thomas (2012) evaluated two types of learning modules—resources and interactive components—in which students engage in a virtual learning environment (VLE), to determine which module increased measures of students' critical thinking. The results of the study showed that when students engage in the interactive components module of the VLE it contributed more to their critical thinking than when students engaged in the resource module. Other studies have indicated that the quality of student learning has a direct effect on student grades (Cross & Angelo, 1988; Fehrmann, Keith, & Reimers, 1987).

Impact of student engagement on grades. Grades are a form of assessment. More specifically, Cross and Angelo (1988) define grades as "a form of summative assessment where students are measured by the level of success or proficiency they have obtained at the end of an instructional unit or course term by comparing them against some standard or benchmark" (p. 20). The purpose of summative evaluations is to *judge* individual student's achievements by informing educators what students have learned and how well they have learned it (Angelo & Cross, 1993; Cross & Angelo, 1988). The criteria for assessing students' progress is to assign a grade presented as either pass-fail, credit-no credit, or on a scalar quantity expressed with letters or numbers ranging from A through F or 1 through 100, respectively. The criteria are typically linked to some national, university, or classroom standard (Cross & Angelo, 1988).

Grades have been linked directly to the level of student engagement (Junco, 2012; Kuh et al., 2008). In "Unmasking the Effects of Student Engagement on First-Year College Grades and Persistence," Kuh et al. (2008) used regression analysis to produce two models illustrating the impact of student demographics, pre-college experiences, and student engagement on first-year

GPAs. The first model compared students' demographic characteristics, pre-college experiences, and prior academic achievement with GPAs. Results showed a 29% variance in first year grades. After adding the student engagement measure to the model, an additional 13% variance was added to first-year GPA resulting in a total variance of 42%. Kuh et al.'s study demonstrated a positive relationship between students' GPA and its connection with student demographics and student engagement.

In an earlier study by Carini et al. (2006), the researchers correlated students' self-reports on various engagement measures of the National Survey of Student Engagement (NSSE) and their respective GPA. Results again showed the positive relationship of student engagement and GPA. There was modest but statistically significant positive partial correlations in at least five engagement *clusters*: level of academic challenge, active and collaborative learning, student-faculty interactions, enriching educational experiences, and supportive campus environments.

Impact of student engagement on retention rates. Higher grades lead to student persistence and ultimately college completion (Klem & Connell, 2004; Kuh et al., 2006, Tinto, 1997). According to Arnold (1999), college grades are the most important factor that influences a student's intent to persist. *Persistence* and *retention rate* are typically discussed together in research articles, but each term has its own distinct definition. Persistence describes a student's continued actions leading to a desired goal, and retention rate measures the percentage of freshmen that re-enroll the following academic year as sophomores. Other terms found in the literature related to persistence and retention include: attrition (school's loss of students), completer (student who finishes a program), dropout (student who leaves school and does not return), matriculate (student who enrolls at a school), and graduate (student who completes graduation requirements).

When students do not persist in school, colleges and universities lose resources necessary to operate efficiently, especially at a time when institutions are faced with steep budget cuts and limited finances. DeBerard, Spielman, and Julka (2004) summarize losses by stating, "each student that leaves before degree completion costs the college or university thousands of dollars of unrealized tuition, fees, and alumni contributions" (p. 66). In addition, decreased retention rates can potentially damage a school's reputation, creating long-term implications for attracting potential students (Ozga & Sukhnandan, 1998). Unfortunately, colleges and universities have notoriously experienced low retention rates across the nation.

According to the NCES (2012), approximately 79% of first-year, full-time students who enrolled in a 4-year institution in 2009 enrolled the following year as sophomores. At 2-year institutions, the retention rate in 2009 was much lower for first-time, full-time students at 61%. Graduation rates, measured by the number of students who have completed all graduation requirements within 6 years, were much lower than the aforementioned retention rates at 58%. In other words, for every 100 first-year, full-time students, only 42 students graduate in 6 years. With low retention rates pervasive in colleges and universities across the country, it is imperative that institutions find ways to increase student engagement to reduce the potential of students dropping out.

In the late 1990s, empirical studies began to investigate the relationship between student engagement and persistence. Empirical studies focused on factors that contribute to persistence. For example, Tinto (1997) focused on the classroom setting because he believed this is where student engagement occurs, whereas Anderson's (2010) and McCourt and Carr's (2010) studies focused on best practices that increased student engagement to ensure college graduation.

Tinto (1997) realized that connections between student experiences and persistence occurred in the classroom setting. He argued that more focus should be placed on the classroom since this is where social and academic skills meet. In other words, social involvement and academic offerings occur in the classroom. Tinto altered classroom experiences by implementing learning communities and adopting collaborative learning strategies to determine the degree to which strategies enhance student persistence. Students in the Coordinated Studies Program (CSP) were given a survey; the results confirmed that students in the CSP reported greater involvement in academic and social activities than their non-CSP counterparts. As expected, CSP students persisted at a significantly higher rate than non-CSP students the following fall quarter at a rate of 67.7% and 52.0%, respectively.

Anderson (2010) conducted a case study to examine the engagement of socially and academically disadvantaged students at nine higher education institutions in New Zealand. The researcher explored various aspects that support student persistence. Students from six different programs and a variety of disciplines were given a survey to identify their priorities. Correlations were made between student priorities and learning experiences and the calculations were then linked to retention data. Findings suggest that programs where student priorities were highly correlated with student learning experiences had higher retention rates.

At the University of Ulster in the UK, changes in governmental policies were made to increase enrollment of younger, disadvantaged students. McCourt and Carr (2010) set out to address the unintended consequences of increased diversity, lowered student engagement levels, and decreased retention that resulted from these changes by implementing small group tutorials for first-year students in a computer science course. The small group tutorials were made up of approximately 15 students. The tutors provided sample problems for each group to work out

together and made themselves available for individual assistance as well. Results of the study showed that small group tutorials increased student participation in class. Approximately 80% of the students agreed or strongly agreed that they felt more comfortable participating in small group discussions. Higher participation rates were positively related to enhanced student engagement and higher student retention. McCourt and Carr found that retention rates from 2007-2008 academic year showed a slight increase the following academic year from 70.5% to 73.4%, respectively: a 2.9% increase.

Online Education, LMSs, and Student Engagement

The recent growth of online learning and widespread adoption of LMSs have prompted educators and researchers to rethink the way education is delivered (Allen & Seaman, 2011; Bacow, Bowen, Guthrie, Lack, & Long, 2012). An LMS is a software system that provides a variety of tools specifically designed for faculty to engage students in the learning process. In the early years, educators did not take advantage of the variety of tools integrated into LMSs. Rather early LMS adoption was used primarily as a placeholder to post syllabi and class notes (Harrington, Gordon, & Schibik, 2004). Steady technological acceptance and increased awareness of the importance of student engagement in promoting learning, improving grades, and increasing retention rates have prompted educators to continue using LMSs as more than just a repository, but rather as a central hub to promote critical thinking, student-student interactions, and student-teacher interactions. Delivery of instructional content has evolved from having students passively download course material to actively participating within the LMS and interacting with the instructor and peers (Beer et al., 2010).

Online education. Online education is commonly referred to as e-learning, distance education, distributed learning, and distance learning. The term *online education* is a generic one

that does not refer to a specific application or tool, but rather to the field of learning online using a networked computer (Harasim, 2011). For the purposes of this study, the term *online education* is used to describe a variety of applications and tools used for formal and informal course delivery. Moore and Kearsley (2012) define online education or distance learning as simply education for which the instructor and students are located at different places while teaching and learning for the majority of the time. Allen and Seaman (2011) provide a more precise definition for distance learning as courses in which at least 80% of the material is delivered online. Online education is offered at nearly every college and university in the nation (Bacow et al., 2012). Moore and Kearsley state, "during 2006-2007, 81 percent (1,179) of degree-granting institutions offered distance education courses" (p. 49). The increase in distance education courses coincided with the increase of students taking at least one online course from 9.6% in 2002 to 32.0% in 2011 of the total enrollment of degree-granting postsecondary institutions (Allen & Seaman, 2013). Many reasons are cited for this growth. Bacow et al. (2012) assert that online education is an effective means to provide access to students who would not otherwise be able to enroll in traditional colleges or universities. Other reasons include improving retention rates and responding to space restraints. With the ready availability of the Internet and the rapid growth of online education, it is imperative that higher education institutions seek to provide quality learning experiences.

Robinson and Hullinger (2008) call for greater accountability and evidence of quality teaching and student learning as higher education institutions experience extraordinary growth in online education. Factors that improve online learning include allowing students to self-regulate their learning, providing better measures of student readiness, and improving evaluation of student outcomes (Kim & Bonk, 2006). However, Robinson and Hullinger state that evaluation

of online learning needs to go beyond measures of student outcomes and consider the quality of education as measured by student engagement. Since online learning is typically hosted in higher education institutions' LMSs, it is imperative to understand what is an LMS, the role it plays in online education, and what features promote student engagement.

Learning Management Systems. LMSs, commonly referred to as *learning platforms*, *course management systems* (CMSs), *virtual learning environments* (VLEs), *Learning Management Content Systems* (LMCS), and *e-learning systems*, can be defined as "enterprise-wide and internet-based systems...that integrate a wide range of pedagogical and course administration tools" to enhance student learning (Coates et al., 2005, p. 19). McGill and Klobas (2009) define an LMS as a system that facilitates e-learning by providing educators the necessary tools to manage administrative tasks; process, store, and disseminate educational materials; and support communications and interactions associated with teaching and learning.

LMSs are typically launched on a large scale, usually across an entire university, and adopted by faculty who use them to manage students and course material and augment student learning (McGill & Klobas, 2009). These systems have been created within higher education institutions in direct response to a lack of tools to support online teaching and learning, and can be used in a variety of ways from augmenting traditional face-to-face classroom environments to developing fully online virtual universities (Gibbons, 2005). Coates et al. (2005) confirm that these systems have the capability to produce a virtual learning environment for students who are based on and off campus, allowing learners to be connected to course material anywhere, at any time. Faculty choose to adopt these software systems for many reasons; LMSs reduce expenses by allowing institutions to distribute a vast amount of information to many students at low costs (Evans & Haase, 2001), enhance student access (Clarke & Hermens, 2001; Golden, 2006), save

time, are convenient, and improve student learning (Gibbons, 2005). According to Robbins (2002), a key reason to adopting LMSs is the ease of use and automated authoring applications these software systems contain. Simple tools give educators, who are content experts but have little or no programming experience, the ability to author content quickly and easily without the assistance of a computer programmer (Gibbons, 2005; Oliver, 2001; Robbins, 2002). A variety of companies provide a suite of teaching technologies that make it easy for faculty to use technology for instruction.

A variety of corporations provide LMSs to higher education institutions. These corporations can be broken down into two broad categories: *proprietary* and *open source*. Proprietary companies are privately owned corporations that allow educational institutions to purchase a license to use their product. For example, Blackboard, WebCT, Desire2Learn, and Angel are proprietary LMSs that allow schools to pay a fee to install their software on either the school's or the vendor's hard drive. Schools are then able to use these hassle-free LMSs while the company is responsible for managing, maintaining, and updating the system (Chen, Lambert, & Guidry, 2010). The two leading proprietary LMSs are Blackboard and Desire2Learn. Conversely, open source LMSs are free educational systems that allow educational institutions to download and use the software at no cost. Although these systems contain the same features and functionality as proprietary systems, they are typically installed, managed, and updated by the user, making these systems more difficult to maintain (Simonson, 2007). Because of economic constraints, open source systems have become increasingly popular with colleges and universities. There has been a steady adoption rate of open source systems, such as Sakai and Moodle, by administrators and educators. Both proprietary and open source LMSs provide

similar pedagogical tools, which provide administrators and educators the capability to build, design, and deliver quality online learning programs (Coates et al., 2005).

Leading LMSs, whether proprietary or open source, provide the same essential tools to build, design, manage the course, and enroll students. Typical LMS features include: syllabus, course calendar, announcements, student roster, and a glossary. LMS tools can be organized into key building blocks: managing; designing, developing and delivery; collaborating and communicating; grading and assessment; and third party tools (Robbins, 2002).

Management tools allow administrators and educators to be in control of the LMS. Authentication features allow the system to identify users when they enter an assigned username and password. The system recognizes the information and grants access to the system (Blackboard™, 2013). Authentication provides a layer of security, which is common for LMSs. Robbins (2002) describes LMSs' sophisticated security and encryption mechanisms that protect the course content and user data. As part of the systems security, users are given specific privileges depending on their course role: administrator, teacher, or student (Avgeriou, Papasalouros, Retalis, & Skorkalaks, 2003). Instructors can access and control users' roles, granting varied levels of permission. For example, graduate students may be given teacher privileges so that they can grade assignments and update the gradebook (Robbins, 2002). Administrators and instructors have the option to enroll or un-enroll users directly from the course home page, or they can allow students to self-enroll. Students can also un-enroll themselves if they decide they are no longer interested in the course. For large classes, administrators can enroll and un-enroll blocks of students in batches to save time (Blackboard™, 2013). In addition to adding or dropping students from LMSs, teachers can create groups and assign students to groups. Within the group space, members can chat, exchange email, and share

documents for group discussion and revision (Simonson, 2007). Controlling access, permission levels, and groups are only part of the powerful tools educators can manipulate; educators have the ability to design, develop and deliver important course information.

Develop and deliver tools allow instructors to initiate and build courses, design and organize material, and develop and deliver pertinent content knowledge. Instructors have the option to establish and build new courses, whether transforming a traditional face-to-face class to a completely online course or creating an entirely new online course. LMSs provide the necessary tools for teachers to construct an entire class from scratch with prompts and cues to allow for easy design and organization. Teachers can add and organize newly created content using the LMS's built-in templates. For example, Desire2Learn™ (2013) allows instructors to pick from a number of different layouts with engaging fonts, graphics, colors, and backgrounds. The course builder uses drag-and-drop features, which allows teachers to organize and manage the material in easy-to-follow and intuitive formats. Educators are experts in their field of study but many times lack the knowledge and skills necessary to build their own online course. LMSs give instructors the flexibility to create their own content knowledge material with the internal webpage (Simonson, 2007). The web page has web-editing tools with or without the option of using HTML codes, which allows instructors to add labels, bold text, and highlight key points. Faculty can also create material offline with simple Microsoft Word documents, PowerPoint presentations, and media, such as video, audio, and photos. LMSs allow instructors to archive course content and display internal web pages, upload files, and link external websites (Sakai™, 2013). In addition to uploading and providing links to static resource pages, instructors can implement tools that encourage collaboration and communication between students and the instructor.

Built-in collaboration and interaction tools are similar to external web 2.0 tools (wikis and blogs), and synchronous (instant chat) and asynchronous (email and discussion forums) communication tools. Collaboration features are "tools that are highly participatory and promote collaboration, networking, sharing, generating content, and editing and mixing content from diverse sources for new purposes through a model called mash-up by both groups and individuals" (Simonson, 2007, p. 244). An example of a built-in collaborative tool is the LMS's wiki. Wikis are an online writing space designed to allow students to create and edit a Word document collaboratively, which may be accomplished as a small group or as a whole class assignment (Sakai™, 2013). Blogs are another collaborative tool incorporated into LMSs. The word *blogging* comes from the term *web logging*, and is a form of online reporting or journaling. This is an excellent tool for students to reflect on learning experiences and self-publish personal works (Simonson, 2007). A glossary is similar to a wiki where students may add and edit a working document, but usually in the form of definitions or explanations of terms that appear in learning material. Glossaries are intended to provide contextual definitions for terms used within an LMS site (Sakai™, 2013).

Communication tools are a powerful feature that fosters engagement and encourages interaction between faculty and students, and students and students. The instructor and students can communicate in a variety of ways: either through one-way communication channels; via announcements and calendar; or through two-way communication channels, via chats, emails, and discussion forums. Course announcements can be personalized and customized. The announcement feature allows instructors to "post current, time-critical information to a site" (Sakai™, 2013, para. 1). Personal messages can be pushed to a third-party email addresses so that students can manage all communications through a single site and see important

announcements in a timely manner. The calendar tool is another feature that enables both private and public announcements and can also be linked to personal services (Avgeriou et al., 2003). Both the instructor and students have the capacity to add personal events and export detailed events to third party calendars, such as Outlook or Google Calendar (Blackboard™, 2013). Course items created with due dates are automatically added to the calendar. Users can also personalize their calendar, filter events by course, apply different colors and labels, and view by month, week, or day. Sakai™ (2013) and Blackboard™ (2013) keep track of deadlines of activities, quizzes and site-related events.

Two-way communication is accomplished via instant chat, email, and discussion forums. Instant chat is a common feature that allows for synchronous communication (Desire2Learn™, 2013). Users who log in at the same time initiate the chat tool by typing messages to others in the *chat room*. Once sent, recipients read messages instantly and post a reply immediately. Email capabilities elicit communication on many levels: one-to-one, one-to-several, one-to-all, and within groups (Simonson, 2007). Discussion forum is one of the most widely used tools that has the ability to stimulate interaction and engagement between students (Blackboard™, 2013). Educators control how students view messages. Students either view all messages at once in a thread with inline replies, view messages once they post an original post, or view messages as a *nested thread* where users view threads within threads (Moodle™, 2013). Not only do instructors control when discussion forums are opened and closed, but they also have the ability to duplicate, move, edit, and delete all discussion forum posts. Communication tools permit students and instructors to exchange pertinent information. Grading and assessment are additional powerful tools faculty use to communicate information about student learning with students, colleagues, and educational institutions (Walvoord & Anderson, 2009).

Grading and assessment tools are an essential component of LMSs that provide updates and feedback to students, enabling them to monitor their progress. When teachers post assignments or activities online, grading can be done directly within the LMS. Teachers view completed assignments and activities, add comments and grade marks, and allocate points (Moodle™, 2013). To help with the grading process, *rubrics* are used extensively. A rubric is a scoring tool that faculty use to lay out expectations for an assignment (Stevens & Levi, 2005). Stevens and Levi (2005) define rubrics as "a detailed description of what constitutes acceptable or unacceptable levels of performance for each of those parts" (p. 3). Grades and comments are automatically imported to the gradebook where students monitor their progress and regulate their academic performance. The gradebook stores, calculates, and distributes grade information to students (Sakai™, 2013). In Blackboard™ (2013), instructors have the capacity to assign a color code, a visual indicator criterion, to spot trends of students who are at risk of failing, allowing for early intervention.

Other LMS features that track students' progress include online tests, quizzes, surveys and polls. Settings for online tests, quizzes, surveys, and polls may be set for automatic grading. Instructors create exams by adding questions to the question bank. Using the built-in tools, instructors are able to generate questions in a variety of formats: true-false, multiple choice, multiple answer, matching, short answer, and essay (Simonson, 2007). Questions can be reused in the same course or transferred across courses of the same instructor. Custom settings provide a timer to ensure auto-submits, even if the student isn't finished (Blackboard™, 2013). Students obtain a confirmation notification to let them know the instructor will receive the submission. Statistical analyses and reports can be generated to summarize students' performance.

Students' activity reports are available for administrators, instructors, and students. Administrators have access to any course in the system and to all users, instructors are limited to their individual courses and students, and students are limited to their individual report (Blackboard™, 2013)). Activity reports typically include the user's name, date, and timestamp, and may be more robust or streamlined, depending on how the administrators set the filtering options. Reports may track items, such as logons, submissions, class averages on assignments, activity logs, frequency of forum posts, and complete and incomplete items. Student activity reports provide more insight into how students are interacting with the courses, the instructor, and other students (Simonson, 2007). Other reports that are generated from many LMSs include standards, objectives and goals, and whether the course is aligned to these benchmarks (Blackboard™, 2013). For example, content pages, assignments, and assessments are aligned directly to the stated standards and goals. Reports on student performance as well as goal coverage are critical to reviewing overall program and student performance and provide greater visibility for learning outcomes. Blackboard™ (2013) generates three types of reports: course performance, learner performance, and goal performance.

Built-in tools have a variety of features and serve different functions, but third-party plug-ins may provide additional features and functions that enhance and extend LMSs capabilities, thus enriching their educational value. Both Desire2Learn™ (2013) and Blackboard™ (2013) have partnered with textbook publishing companies to provide online course materials that supplement textbooks and integrate directly into the course shells (Simonson, 2007). These may include learning goals and objectives, update to texts to keep the information current, annotated URLs to relevant websites, and case studies and problem-based learning situations for use in class discussions. Another valuable plug-in that both proprietary

and open source LMSs use is Turnitin™: a plagiarism detection service (Turnitin™, 2013). Turnitin™ (2013) software scans uploaded student papers on behalf of the instructor and compares documents against 24+billion websites, 250+ million student documents previously uploaded in their repository, library databases, and publications to check for similarities. Turnitin™ software is integrated into many proprietary and open source LMSs. Black, Beck, Dawson, Jinks, and DiPietro (2007) have suggested that all LMSs basically have the same features and functions and that the only real difference lies in their marketing. Therefore, many studies have focused on which LMS is the right system to adopt by studying factors of acceptance and continuance.

Shaping LMS use: Adoption, acceptance, and continuance. During the early development of LMSs, faculty used the system mainly for distributing learning materials, communicating with students, and for the convenience of making the online gradebook available to students (Harrington et al., 2004; Morgan, 2003). Early studies focused on *adoption*, *acceptance* and *continuance* of LMSs rather than strategies using the built-in tools for student learning. A 2001 study by De Boer and Collis (2001) described an institution-wide LMS adoption process for teaching and learning. The researchers described how the 4E model—Educational Effectiveness, Ease of Use, Personal Engagement, and Environmental Factors—was necessary for predicting the implementation success. Black et al. (2007) state, "if an innovation is perceived as better, more efficient or more effective, it is more likely to be adopted" (p. 37).

Dasgupta, Granger, and McGarry (2002) used Davis' Technology Acceptance Model (TAM) to determine users' acceptance of the LMS. Investigators found that an individual's technology acceptance depended on the perceived ease of use and perceived usefulness of the technology. The study found mixed results where perceived ease of use did have a significant

positive relationship to perceived usefulness of the system, but the main factor determining the use of the system was level of prior use. Roca, Chiu, and Martínez (2006) extended the TAM model to include the Expectancy Disconfirmation Theory (EDT) to determine the variables that motivate individuals to continue using information technology. The researchers found several predictors that contribute to a users intent to continue using an LMS, including satisfaction, perceived usefulness, information quality, confirmation, service quality, system quality, perceived ease of use, and cognitive absorption. Lee's (2010) study confirmed satisfaction as the most significant factor that determines a user's intention to continue using e-learning, followed by perceived usefulness, and attitude, after combining Expectation-Confirmation Model (ECM), Theory of Planned Behavior (TPB), TAM, and flow theory. St. Clair and Backer (2003) sent out a national survey to determine faculty perceptions of LMSs and its tools. The majority of the respondents stated that the easier, simpler tools were perceived as most effective and useful; therefore, they were used the most. Respondents felt the more complex tools were used less often and therefore rated the lowest for effectiveness and efficiency. The findings of St. Clair and Backer's study contrasted starkly with more recent research that focuses on the more complex and interactive tools that are favored to promote student engagement and achievement.

Once institutions and faculty accepted and adopted LMSs, they began to see increased uses for it in teaching and learning. Currently, LMSs are increasingly being used to promote student engagement using the more complex, interactive tools, such as group construction of wiki pages, student feedback features, synchronous videoconferencing and chats, and asynchronous discussion forums and messaging (Moore & Kearsley, 2012). The following studies show the transition of LMSs toward best practices that promote teaching and learning.

One of the earliest studies that explored pedagogical considerations when implementing LMSs to their teaching was conducted by Govindasamy (2002). The investigator identified five pedagogical principles—developing content, storing and managing content, packaging content, student report and assessment—that are essential in deploying effective online teaching and learning. Govindasamy claimed that not adhering to these five parameters would undermine the implementation process. Wang, Doll, Deng, Park, and Yang (2013) applied Chickering and Gamson's (1987) seven principles and found that an LMS was pedagogically effective in helping faculty with teaching practices by reconfiguring the online appearance, the course material, and the ways faculty interact with students.

Student learning using LMSs has also been studied. Vovides, Sanchez-Alonso, Mitropoulou, and Nickmans (2007) support the value of self-regulated monitoring of one's learning strategies and metacognitive skills. The researchers believe that if LMSs could be designed to provide the necessary scaffolding to help students become more aware of their own learning strategies and metacognitive abilities, it would enhance their learning efficacy. Saadé et al. (2012) assessed which tools and to what extent an LMS promotes critical thinking in students. According to survey results, students felt that interactive components contributed significantly more to critical thinking than resource components. In an earlier study, Ebner (2007) was one of the first researchers to marry web 2.0 and e-Learning 1.0. Ebner coined the term e-Learning 2.0 and called for engaging students in more interaction between the learner and the content, the learner and the instructor, and the learner with other learners.

LMSs and student engagement. In traditional face-to-face classrooms, simple measurements of student engagement typically involve observing students' behavior through attendance, eye contact, posture, and asking questions. However, in online environments, it is

much more difficult to monitor student engagement given the subtlety of students' behavior (Romero & Ventura, 2007). LMSs allow for every mouse click from each student within the system to be recorded. These data may be tracked for analysis and used to gauge a student's level of involvement (Beer et al., 2010). Rapuano and Zoino (2006) inform readers about LMSs' ability to retrieve detailed data on learner scores, choices on questions, and navigation habits, which provide important data on students' engagement behavior. Although this may be true, Beer et al. (2010) argue that while LMS data has the potential to measure student engagement, research into how this can be done is still in its infancy.

Hu and Kuh (2002) assert that student engagement is a function of interaction; more than 80% of interaction that occurs in an LMS occurs in the discussion forums (Dawson, Macfadyen, & Lockyer, 2009). Student engagement is related positively to student interaction with instructors and other students. Many empirical studies have explored interactions in discussion forums. One of the earliest studies using discussion forums to increase student engagement was Persell's (2002) "Using Focused Web-based Discussions to Enhance Student Engagement and Deep Understanding." This study addressed pedagogical problems in her weekly senior sociology seminar where students came to class not having read the course readings; therefore, they were not ready to discuss the issues on a deeper level. In addition, not all students participated in discussions. To acquire greater participation, to get students to read course material, and to think and write about the issues more analytically and sociologically, Persell used discussion forums to get "staters", students who initiated posts, to report about the reading before class, "responders" replied to staters' posts by extending ideas, and then "integrators" combined previous ideas and posted additional questions. Persell counted the number of times students referred to their peers by name in the discussion boards to assess the degree of student

engagement. Results of the study revealed that students became more engaged by the end of the semester by referring to their peers by name 100% of the time compared to 30% during the first week of school.

In 2009, three separate studies assessing student interaction in discussion boards were performed, and each study had similar results. Dawson et al. (2009) correlated learning dispositions with student LMS data to identify patterns of student achievement in first-year medical students at the University of Wollongong in Australia. Results showed a strong correlation between student achievement and participation in discussion forums. Sher (2009) implemented regression analysis to analyze the relationships between student-student and student-instructor interactions in asynchronous discussion forums with student learning and satisfaction. The researcher concluded that interaction variables contributed significantly to student learning and satisfaction. Bliss and Lawrence (2009) provided further evidence by evaluating 11,596 message posts from 14 online undergraduate Mathematics courses at Empire State College in the winter 2008 term. Student participation was calculated by the number of students participating in a thread divided by total number of students enrolled in the course. The researchers confirmed findings of earlier studies that suggest guidelines, feedback, and instructor presence are correlated with greater student participation.

More recent studies have explored ways to increase student interactions in discussion forum posts. Ertmer, Sadaf, and Ertmer (2011) examined relationships between question types and critical thinking levels, as described by Bloom's taxonomy (elucidated previously), to levels of student interactions in online discussion forums represented in number of responses per student, average number of student-student sequences, and average number of threads for each

question. The study's results showed that higher-order thinking questions produced a higher frequency of student interaction.

Tracking Student Behavior: Data Mining and Analytics

Data mining and learning analytics are starting to emerge in the educational landscape as online techniques to improve student outcomes. Educational data mining researchers began meeting annually at international educational data mining conferences in 2008 with the inauguration of the *Journal of Educational Data Mining* in 2009 (Baker & Yacef, 2009). The International Conference on Learning Analytics began meeting annually since 2010 and its professional society was founded in 2011 (Bienkowski et al., 2012).

Educational data mining. Educational data mining is described as "an emerging discipline, concerned with developing methods for exploring the unique types of data that come from educational settings, and using those methods to better understand students, and the settings which they learn in" (Baker & Yacef, 2009, p. 2). In other words, educational data mining is concerned with developing methods—such as clustering, decision tree construction, rule induction, etc.—to explore a vast amount of data to discover patterns that help researchers to understand students, how they learn, and the environment in which they learn. Data mining is a *discovery* method where the hypothesis is extracted from the data (Ferguson, 2012; Romero & Ventura, 2007), whereas analytics is an *application* method where the hypothesis is known and is used to collect data and answer questions about student learning (Bienkowski et al., 2012).

Educational data mining methods emerged from analysis of student-computer interaction logs (Baker & Yacef, 2009). Romero and Ventura (2007) surveyed the application of data mining in a variety of web-based educational systems in higher education, including web-based courses, different learning management systems, and adaptive systems from 1995 to 2005. Data

mining techniques can be categorized into two broad categories: statistics and visualization, and web mining. Web mining includes clustering, classification, and outlier detection; association rule mining and sequential pattern mining; and text mining. Baker and Yacef (2009) offer an alternative view to educational data mining methods. The first three methods of Baker and Yacef's taxonomy align with traditional data mining techniques: prediction (classification, regression, density estimation), clustering, and relationship mining (associated rule mining, correlation mining, sequential pattern mining, causal data mining). Baker and Yacef's fourth category, distillation of data for human judgment, is similar to Romero and Ventura's aforementioned statistical and visualization category. The fifth category, discovery with models, is validated from another method and then used as a component in subsequent data mining analyses. The different methods of educational data mining have been applied to various research studies.

Applications of educational data mining. Although relationship mining is the most cited mining method used in educational data mining research (Baker & Yacef, 2009), many studies have used multiple approaches to classify data, find patterns, or discover models. Zaïane and Luo (2001) used relationship mining and association rule mining to discover patterns in students' online behaviors. The researchers sought to discriminate between learners' online behaviors to assess how students learn and the effectiveness of the course structure. This study has helped shape Zaïane's (2002) research on a recommending software system. The researcher used association rule mining to build a model that represented users' behaviors so that the software could recommend online learning activities to help student learn relevant material faster and to improve academic performance. Tang and McCalla (2005) published a similar study, but

used clustering and collaborative filtering techniques to classify students and recommend content, activities, and shortcuts to improve student learning.

More recent studies have focused on using educational data mining for its predictive powers to create student models. A variety of models have been created to predict whether students will choose the correct answer (Beck, 2007; Mavrikis, 2008). For example, Baker and Yacef (2009) documented difficulties in mapping observable student performance to estimate students' level of knowledge and underlying skills when using data mining techniques. The difficulties the researchers encountered helped them propose guidelines for constructing and evaluating a student model. Abdous, He, and Yen (2012) used predictive and analytical techniques to understand students' learning experiences and their relationship to student performance in class. The investigators used clustering analysis from data generated form LMSs to identify emerging themes of students' texts from the discussion forums and chat features. Four major themes emerged from students' written transcripts: check in, deadline/schedule, evaluation/technical, and learning/comprehension. Regression analysis was used to determine if there was a relationship between the textual theme and a student's final grade. Results show that there were no correlations.

Clustering methods have also been used to evaluate courses rather than just students. In 2012, a group of researchers proposed specific metrics to assess online courses by evaluating students' online usage (Kozanidis, Valsamidis, Kontogiannis, & Karakos, 2012; Valsamidis, Kontogiannis, Kazanidis, & Karakos, 2012). Results show that clustering methods may help to quantify the quality of a course. In addition, the findings may provide insights for students and their usage of the LMS and help them self-monitor online behaviors.

Analytics. Analytics is a hypothesis-driven method that involves collecting and analyzing data to solve educational problems, such as student learning, improved grades, and increased retention rates. Because of its recent inception in educational literature, many studies have used the term *analytics* loosely, resulting in multiple or ambiguous meanings. Long and Siemens (2011) have offered clarifying definitions for *academic analytics* and *learning analytics*. Academic analytics is the application of statistical techniques to large datasets to produce *actionable intelligence*—immediate access to student data, prompt analyses, and swift action—on an institutional, regional or international level (Baepler & Murdoch, 2010; Long & Siemens, 2011), whereas learning analytics refers to data collected and analyzed that is focused specifically on student learning at the course or departmental level.

Although the term academic analytics entered the educational conversation around 2005 (Goldstein, 2005), it has been implemented in higher education for over a decade. Since the late 1990s, Baylor University has been using a sophisticated freshman admission strategy by collecting and interpreting massive amounts of data on prospective students to determine which students are more likely to attend. Analytics have also been used to improve student retention at the University of Alabama. The university developed a predictive model by looking at eight variables—cumulative GPA, English course, English course grade, distance from campus to home, race, math course grade, total earned hours, and highest ACT scores—to identify freshmen who were at risk of dropping out (Campbell et al., 2007). In 2006, Campbell et al. (2007) tripled their predictive power of identifying at-risk students by adding a second variable (number of student LMS logins) to a student's SAT scores. This study demonstrated a positive relationship between the number of logins, standardized test scores, and student achievement.

According to the First International Conference on Learning Analytics and Knowledge, "learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (gsiemens, 2010, para 5). Johnson, Adams, and Cummins (2012) assert that learning analytics applies mainly to monitoring and predicting student performance and recognizing at-risk behaviors so that interventions may be put into place. Several institutions and researchers have begun applying learning analytics into their research projects. For instance, the Society for Learning Analytics Research (SoLAR) is offering a free online course introducing learning analytics at Athabasca University. Harvard University has developed a software called *Learning Catalytics* that provides real-time feedback while students are in class by grouping students together based on questions posed (Learning Catalytics, n.d.). In 2007, Purdue University initiated their Signals project, which gathers information from a variety of sources, such as the course management systems and gradebook, to generate an at-risk profile and target those students for outreach (Johnson et al., 2012). The University of Maryland has also made use of data extracted from Blackboard, their institution's LMS, and developed a program called *CheckMyActivity*, which allows students to access their data to check and regulate their progress at any time (Lonn, Krumm, Waddington, & Teasley, 2012). These studies will help faculty to better understand their students' needs and tailor instruction to meet those needs.

Applications of learning analytics. Learning analytics is relatively new in the academic field, and empirical studies have been increasing in the educational literature (Siemens, 2012). Higher education institutions have adopted learning analytics to inform enrollment decisions, improve fundraising, and to better understand dropout and retention patterns (Johnson et al., 2012). Recent studies have focused on the use of learning analytics to predict student

performance. Mogus, Djurdjevic, and Suvak (2012) examined students' activity logs from an LMS to determine whether their activity logs correlated with their final marks. The researchers also correlated students' activity logs with their perceptions of using the LMS. Results showed a strong correlation between students' activity logs and their final marks and their perceptions of LMS usage. Fritz (2011) also extracted students' LMS activity logs and correlated the data with students' performance as measured by grades. The researcher concluded that a relationship exists between student success as defined by grades and a students' LMS activity. Students earning a final grade of a D or F used the LMS an average of 39% less than students earning a C or higher. Siemens (2012) stated that learning analytics have focused on identifying at-risk behaviors to increase student success. Identifying at-risk behaviors, such as failing a course or dropping out of school, by using learning analytics is an important aspect to understand. These early identifiers can help improve student success. Learning analytics should also include "social network analysis and content recommender systems, automated marking, improved learner self-awareness, and real-time feedback for education" (p. 4) to optimize student learning outcomes.

Research on data mining and analytics measuring student engagement. Limited studies have been performed correlating mined student LMS data and student engagement. Saenz et al. (2011) used data mining techniques to extract a large array of data from 663 community colleges' LMSs and more than 320,000 students to explore patterns of engagement between similar and dissimilar groups. This study found the most distinguishing factor between similar and dissimilar groups was students who utilized the college's student services. Dawson, McWilliam, and Tan (2008) used academic analytics to look at a range of institutional data and create a visual model of student engagement/effort based on faculty activity level. Network analysis was performed on course discussion boards to discover patterns of student-student and

student-instructor interactions to visualize student engagement and the likelihood of success (Macfadyen & Dawson, 2010). Although only a small number of studies have used data mining and academic analytic techniques to explore the relationship between student LMS data and student success, there have been no studies to date investigating the correlation between students' perceived level of engagement and students' actual levels of engagement as measured by an LMS. Long and Siemens (2011) have expressed their amazement regarding the remarkably ineffective use of data in higher education, an institution that has historically collected vast amounts of data. Macfadyen and Dawson (2010) add that "there are few examples that demonstrate successful and systematic application of academic analytics across an institution in order to inform and enhance teaching and learning practices" (p. 590)

Chapter Summary

Student engagement has been studied extensively and can be summarized as the amount of time and effort students put forth toward academic activities. Measures of student engagement offer valuable indicators of quality teaching and learning practices in higher education. Student engagement has been linked positively with improved student achievement, such as higher order thinking, better grades, persistence, and college success.

With a move toward increased online teaching and learning, there has been a greater demand for administrators and educators to demonstrate quality teaching practices and accountability (Robinson & Hullinger, 2008). Consequently, most higher education institutions are under extreme pressure to document student learning outcomes and increase retention rates (Goldstein, 2005).

With the increase of online teaching, an increase in LMS usage has also occurred. LMSs are educational software systems that are designed specifically for faculty and students to

improve teaching and learning in online environments. LMSs are easy-to-use and designed for educators who have expert content knowledge in their field of study but little or no programming experience. Built-in tools help educators manage the course and its students; design, develop and deliver content material; facilitate collaboration and communication activities; track grading and assessment; and add third party tools if necessary. These tools influence how students engage with the course material, and with their instructor and peers. Early empirical studies of LMSs have focused on adoption, acceptance, and continuance. Recent LMS studies have transitioned into pedagogy and best practices for teaching and learning. Since student engagement has been linked to student success, LMSs have the potential to measure student engagement. When students log in, every mouse click is recorded, generating a vast amount of data.

Data mining techniques is a *discovery* method where questions are unknown and large amounts of data are extracted to create a hypothesis. Learning analytics uses the *discovered* hypothesis and collects data to support or reject the hypothesis. Employing learning analytics to extract and analyzed data from an LMS will help universities and colleges to respond to the higher calls for higher accountability and provide practitioners the necessary tool to provide a quality, personalized experience. Correlating students' perceived level of engagement and students' actual LMS data will contribute to the sparse literature in applying learning analytics to improve teaching and learning and provide an early warning system for student failure so that educators can modify teaching methods to increase student engagement.

Chapter 3: Methods

Overview

The academic community has long understood the importance of student engagement and its relationship to positive student outcomes, such as higher-order thinking, improved grades, and increased retention and graduation rates. Engagement is measured by the amount of time and effort a student spends on academically purposeful activities. The more time and energy a student spends studying, participating in collaborative learning, and interacting with faculty and peers, the more likely he/she is to succeed in school. LMSs have the ability to measure student engagement by recording the frequency of logins, the number of page visits, and how often a student views, posts, and replies on discussion forums. Data extracted from an LMS can potentially inform administrators and educators of students' engagement levels and assist in tailoring teaching methods to optimize student achievement. Equally important are students' perception and awareness of their level of engagement in a course. Students who are cognizant of their level of engagement compared to those levels measured by the LMS can monitor their progress and prevent the likelihood of failing a course. Therefore, the purpose of this initial exploratory study was to investigate whether relationships exist between students' perceived level of engagement and students' actual levels of engagement as measured by an LMS of an online course, students' perceived level of engagement and student success, and students' actual level of engagement and student success.

This chapter includes (a) restatement of the research questions, (b) research design and rationale, (c) population and sample, (d) human subjects consideration, (e) instrumentation and data collection, and (f) proposed statistical analysis techniques for this study.

Restating the Research Questions

The following research questions informed the study:

Research Question #1: What is the relationship between students' perceived level of engagement and students' actual level of engagement as measured by an LMS?

Research Sub-question #1a: What is the relationship between students' perceived level of engagement and frequency of student logins in an LMS?

Research Sub-question #1b: What is the relationship between students' perceived level of engagement and frequency of page visits in an LMS?

Research Sub-question #1c: What is the relationship between students' perceived level of engagement and frequency of discussion forum views?

Research Sub-question #1d: What is the relationship between students' perceived level of engagement and frequency of original discussion forum posts?

Research Sub-question #1e: What is the relationship between students' perceived level of engagement and frequency of discussion forum replies?

Research Question #2: What is the relationship between students' perceived level of engagement and student success in an online course?

Research Question #3: What is the relationship between students' actual level of engagement as measured by an LMS and student success in an online course?

Research Sub-question #3a: What is the relationship between students' frequency of logins onto an LMS and student success?

Research Sub-question #3b: What is the relationship between students' frequency of page visits onto an LMS and student success?

Research Sub-question #3c: What is the relationship between students' frequency of discussion forum views and students' success?

Research Sub-question #3d: What is the relationship between students' frequency of discussion forum posts and students' success?

Research Sub-question #3e: What is the relationship between students' frequency of discussion forum replies and students' success?

Research Design and Rationale

This initial exploratory study sought to determine if relationships exist between students' perceived level of engagement and actual levels of engagement as measured by an LMS of an online course, students' perceived level of engagement and student success, and students' actual level of engagement as measured by an LMS and student success. Results from this study can potentially inform administrators and faculty in making data-based decisions to improve teaching and learning practices. After extensive review of the literature, studies of student engagement have demonstrated that higher education institutions are not utilizing captured data from LMSs to make informed decisions to improve student engagement. By studying data, "researchers may assist faculty in tailoring their teaching to optimize student success; guide instructional designers in developing learning resources and organizing courses that facilitate student engagement; and help students to understand more completely their own studying and learning behaviors" (Morris, Finnegan, & Wu, 2005, p. 229). Bienkowski et al. (2012) affirm that data mining and analytics applications should be introduced on a small scale as a strategy to build an accepting culture within higher education institutions to use data to inform decisions regarding student success. Starting small may entail examining data from LMSs and correlating those data with student engagement and success such as this study.

In this initial exploratory study, the researcher employed a correlation design to study multiple variables—students' perceived level of engagement, students' actual level of engagement as measured by an LMS, and students' success rates—to help answer the three aforementioned guiding research questions and related subsequent five sub-questions. The purpose of this correlation design study was to determine the types and strengths of relationships (Popham, 1999), if any, between students' perceived level of engagement and actual levels of engagement as measured by an LMS, students' perceived level of engagement and student success, and students' actual levels of engagement and student success rates.

Variables. Students' perceived level of engagement were measured using Marcia Dixson's (2010) peer-reviewed OSES (see Appendix E). Students self-reported their perceived levels of engagement by responding to a 19-item Likert-style questionnaire, resulting in individual scores ranging from 0 (not at all characteristic of me) to 4 (very characteristic of me). The OSES is comprised of four subcategories: *skills engagement*, *emotional engagement*, *participation engagement*, and *performance engagement*. Skills engagement pertains to ways students interact with the course content by studying regularly and keeping up with the readings. Emotional engagement pertains to ways students make the course content relevant, interesting, and useful by applying course material to their everyday lives. Participation engagement pertains to ways students interact with others by participating online, posting questions on discussion forums, and helping other students. Performance engagement pertains to ways students want to do well in the course by getting good grades and doing well on exams. Response rates yield a total average numeric score ranging from 0 to 76 on the OSES and an average score for each of the four subcategories. Skills engagement and participation engagement include six questions each and can yield an average score ranging from 0-24 for each subcategory. Emotional

engagement contains five questions and can yield an average score ranging from 0-20, and performance engagement contains two questions and can yield an average score ranging from 0-8. A Likert scale is ordinal in nature, but numerical values can be assumed on an interval scale and assigned to individual responses. This gives the researcher the ability to convert ordinal levels into meaningful interval scales. The total score can be summed to arrive at an overall score and then averaged (McCall, 2001). This can also be done for each subcategory; each subcategory can be summed and averaged to yield an interval scale.

Students' actual levels of engagement as measured by an LMS included five datasets that were retrieved retroactively from the LMS's stored database of the online course. Two of the five variables were extracted and analyzed from the entire course shell, which included frequency of total logins and frequency of page visits. The remaining three variables were retrieved from the discussion forum activity logs, which included frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies. Discussion forum views were measured by to the number of times a student visited a discussion forum page but not necessarily contributed to the forum. Discussion forum posts were measured as original threads that initiated a topic for discussion. Discussion forum replies were measured as responses to either an original post or a secondary reply and did not initiate a topic for discussion. Frequency data were numeric variables on a ratio level of measurement.

Students' success rates were also examined. Success rates were determined by examining students' achievement of course objectives based on total points earned compared to total points possible. Students earned points from a variety of activities, such as posting and replying to discussion forums, completing online assignments, taking online quizzes and midterms, and finishing an in-class final exam. Scores were either automatically updated via computer-graded

online assessments or manually entered by the course instructor into the LMS's gradebook feature. Students' percentages were calculated by the system and determined by dividing accumulated points earned by the total points possible and then multiplied by 100 for all course activities.

The developer and researcher of the original OSES purposely excluded demographic questions from her instrument so as not to discourage potential respondents (Dixson, 2010). However, this study included demographic questions on age, gender, ethnicity, educational goals, unit load, GPA, number of hours worked outside the home, number of online courses, online enjoyment, and online experiences because of their possible effect on student engagement (see rationale presented subsequently).

Rationale. With the ever-increasing enrollment in online education and the linkage of student engagement to student success, the peer-reviewed OSES scale, created and developed by Marcia Dixson (2010), and used with the author's permission (Appendix F), was used to measure students' perceived level of engagement in an online environment. Students' perceptions and awareness of their level of engagement in a course may contribute to their successful completion of a course. Zimmerman and Pons (1986) assert that students who self-evaluate and self-monitor their learning have higher rates of achievement. Results from the OSES may provide valuable insight to students' perceptions, thus increasing their rates of success.

LMSs have the ability to capture, record, and evaluate students' progress in an online environment. The system is capable of documenting every time a student logs in, each page a student visits, and all discussion forum views, posts, and replies a student makes (Beer et al., 2010). In turn, researchers can control and extricate the types of data needed for examination. Every click that is recorded provides important evidence of student participation. Beer et al.

(2010) claim student participation is an important predictor of student engagement and success. Research has shown that highly engaged students log on more often and visit more pages of an LMS. Evaluating the frequency of logins and page visits can determine the level of student participation and engagement. Morris et al. (2005) conclude that successful completers have significantly higher participation rates than unsuccessful completers when measuring frequency of logins and page visits. Successful completers are more apt to log on more often and visit more pages of an LMS. Furthermore, students who are more engaged with the course content have a tendency to interact more with their peers.

Discussion forums provide the environment in which the majority of student interaction occurs. Beer et al. (2010) claim that the most adopted LMS tool is the discussion forum because of its ability to promote student interaction and engagement, thus increasing the likelihood of student success. Morris et al. (2005) argue that successful students spend more time viewing discussion forum posts, and have a higher frequency of posts and replies than unsuccessful students. Dixson (2010) asserts that highly engaged students are twice as likely to use discussion forums to interact with other students than students who are less engaged.

Other demographic factors that may contribute to students' level of engagement and success are age, gender, ethnicity, enrollment status, GPA, highest educational goal, number of hours work outside the home, ability and confidence in online learning, and enjoyment of online learning. Research studies have found that personal attributes, such as age, gender, and ethnicity, are significant predictors of student engagement and success (Fjortoft, 1996; Kuh, 2003; Muilenburg & Berge, 2005). Students who have high expectations to succeed are also more likely to be engaged; therefore, educational goals have also been found to be a significant predictor of student success (Astin, 1984; Chickering & Gamson, 1987; Tinto, 2005). Current

enrollment status (number of units taken) and whether a student works outside the home (number of hours worked) have also been associated with student engagement and success (GPA). Kuh (2003) asserts that full-time students are more engaged than their part-time counterparts. This may be due to the fact that full-time students are expected to take more classes, read and write more, and spend more time preparing for classes (Carini et al., 2006; Muilenburg & Berge, 2005). In addition, students who work full-time are less likely to complete school compared to students who work part-time. Finally, students' confidence and ability with online learning have significantly impacted student engagement levels and success rates (Muilenburg & Berge, 2005).

Despite significant LMS adoption by higher education institutions and the growing recognition and acceptance of student engagement as an indicator for student success, knowledge and understanding of LMS's influence on student engagement are still in their infancy (Coates, 2005). Investigating LMS data and exploring student engagement patterns can help administrators and educators adopt policies and teaching methods to promote student achievement.

Population, Sample, and Setting

Population. The target population for this study was undergraduate students who enrolled in one of six CSULA's online courses offered during the spring 2013 quarter. Emails were sent to all online instructors during the first week of spring quarter asking for permission to study their online students. Follow-up emails were sent during the 5th and 10th week of the quarter. Of the six online courses, two instructors declined, one instructor did not respond, and three instructors accepted the invitation. One of the three online instructors that allowed the researcher to study his/her online students did not use Moodle but used his/her own personal website to host his/her course material; therefore, he/she was eliminated from the study.

The two remaining courses for the study were Natural Disasters, an applied Natural Science lower division general education (GE) course, and Race and Culture in the Americas, an upper division GE-themed course. Typically, students who enroll in the lower division Natural Disasters course are non-science majors and register for the course to satisfy the *B3 Applied Natural Science* GE requirement. Enrolled students are typically of freshman and sophomore standing, and less likely to be of junior and senior standing. In contrast, students who enroll in the upper division Race and Culture in the Americas register for the course to satisfy the *H Race, Diversity, and Justice* upper division and diversity GE theme requirement. Enrolled students are typically of junior standing, and less likely to be of freshman and sophomore standing due to the undergraduate GE prerequisites.

The population inclusion criteria included students who had at least a moderate comfort level with basic computer skills. Students were able to navigate the course site, download course material, add to discussion forums, upload course assignments, take quizzes, and check grades with little to no difficulty.

Sample. This study used a non-probability, purposive sampling technique. The possible sample size for the study was approximately 70 students, with 40 students enrolled in the lower division online Natural Disasters course and 30 students enrolled in the upper division online Race and Culture in the Americas course. The researcher used a non-random sampling method to select sample students.

Setting. The setting for the study was online courses that were hosted on CSULA's Moodle LMS. The Natural Disasters course and the Race and Culture in the Americas course were offered to undergraduate students in the 2013 spring quarter. The courses ran for 10 weeks

of instructional time. Students who registered for courses through the Registrar's Office were automatically enrolled in the school's Moodle LMS.

Natural Disasters Course. The Natural Disasters online course was comprised of 10 topics, which included an introduction chapter. Select topics for the course were derived from Hyndman and Hyndman's (2010) *Natural Hazards and Disasters (3rd ed.*), which was a required textbook. A single chapter was covered in one week's time. Each chapter unit opened on Monday at 12:00 a.m. and closed the following Sunday at 11:55 p.m. Students had one full week to complete all chapter requirements. Table 2 provides an overview of the topics covered by week.

Table 2

Weekly Topics of Natural Disasters Course

Week	Topic
1	Introduction
2	Plate Tectonics
3	Earthquake and Their Causes
4	Earthquake Prediction and Mitigation
5	Tsunami
6	Volcanoes: Tectonic Environments and Eruptions
7	Volcano Hazards and Mitigation
8	Landslides and Other Downslope Movements
9	Hurricanes and No'easters
10	Waves, Beaches, and Coastal Erosion

For example, week 1 covered a brief summary of Natural Disasters, an overview of the course format and course requirements, and an introduction to other students and the instructor. All weekly chapters followed similar formats and included the following set-up: weekly outline, course content, discussion forum, activity, and assessment (Figure 2).

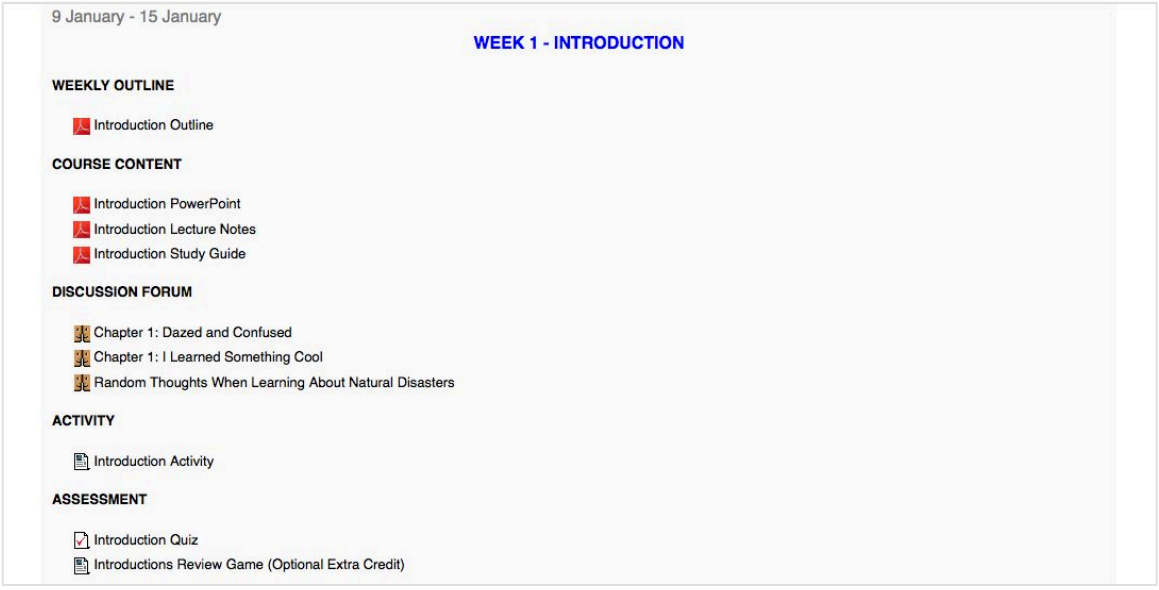

Figure 2. Overview page of online Natural Disasters course interface depicting weekly course format.

Course requirements for the online Natural Disasters course consisted of multiple activities with varying point values (Table 3), such as posting on discussion forums, weekly activities, online quizzes, online midterm, and a face-to-face cumulative final exam. Students could earn a total of 300 possible points.

Table 3

Total Possible Points For Online Natural Disasters Course

Requirement	Points	Total Points
Discussion Forum	5 (x10 weeks)	50
Activities	5 (x10 weeks)	50
Online Quizzes	5 (x10 weeks)	50
Online Midterm	50	50
Face-to-Face Final	100	100
Total Possible Points		300

In a 10-week quarter, students had 10 discussion forum topics, 10 online activities, and 10 online quizzes, one online midterm, and one in-class final examination. Requirements for each portion of the course requirements are detailed in the following sections.

Discussion forum. Students were required to post a minimum of three postings on the discussion forums: one original post and two replies. Original posts needed to be completed by Wednesday the week it was assigned to give other students the opportunity to reply and to encourage dialogue. Posting and replying on discussion forums each week was worth 5 points each for a total of 50 points for the quarter. The criteria for allocating point values were based on three factors: (a) meeting the minimum requirement of three posts, (b) completing the first original post by Wednesday, and (c) adding substance to the discussion topic (i.e., not repeating previous students' comments).

Activities. Participation in weekly activities was also required. Various activities included contributing to a wiki page, blogging, role playing, and reflecting on course topics. Various activities were worth 5 points each for a total of 50 points for the quarter. The criteria for allocating point values were based on two factors: (a) completing the assignment before the due date, and (b) meeting all requirements posted for each assignment (i.e., writing a one-paragraph response relating a personal experience to the posted video). Partial points were given.

Online quizzes. Formative assessments were required throughout the course. Weekly online quizzes were worth 5 points each for a total of 50 points. Quiz questions consisted of 10 questions worth 0.5 points each and were made up of multiple choice, matching, and fill-in-the-blank questions. Quiz questions were based on textbook readings, PowerPoint slides, and lecture notes. Study guides were available to help students focus on important key concepts. To ensure students prepared for assessments, each online quiz and midterm exam was given a set time limit. The weekly online quizzes were set to 20 minutes duration. Once the time limit expired, students were automatically logged off. The number of questions students answered correctly

and the corresponding point value for each question determined the number of points students earned for each online quiz.

Online midterm. The online midterm consisted of 40 questions worth 1 point each and a reflection piece worth 10 points for a total point value of 50 points. The exam portion was administered mid-quarter and consisted of multiple choice, matching, and fill-in-the-blank questions. The reflection piece consisted of students re-examining one key point they learned in the course and relating it to some aspect of everyday life. All online exams were open book, open notes. The online midterm exam was given a set time limit of 90 minutes duration. Once the time limit expired, students were automatically logged off. The number of questions students answered correctly and the corresponding point value for each question determined the points students earned for the online midterm.

Final examination. The final examination was cumulative, closed book, closed notes, and composed of 100 multiple-choice questions worth 1 point each. Students were given 1.5 hours to complete the online final examination. The number of questions students answered correctly determined the points students earned for the in-class final examination.

Students' final marks were based on points earned for completing requirements of discussion forums and online activities, and for answering questions correctly on the online quizzes, online midterm, and face-to-face final examination before the due dates. Total points were converted to percentage marks by dividing points earned by 300 total points possible.

Race and Culture in the Americas. Race and Culture in the Americas was a comparative study of culture, race, and ethnic relations in the Americas. A learning module with different topics was covered each week. Table 4 provides an overview of topics covered by week. Each

learning module was made available to students beginning Monday and closed the following Sunday. For example, week 1 covers *What Do We Mean by Race?*

Table 4

Weekly Topics of Race and Culture in the Americas Course

Week	Topic
1	What Do We Mean by Race?
2	Orientalism
	Medieval Dreams and Renaissance Fantasies
3	The Invention of America
4	Race, Class, Gender, and Miscegenation in Colonial America (1492-1821)
5	Natives, Africans, and Mexicans in the US (1776-1861)
6	Post-US Civil War, Jim Crow, Immigration, and Whiteness (1865-present)
7	Race in Latin America (1804-1920) Part I
8	Race in Latin America (1804-1920) Part II
9	Race in Latin America (1920-present)
10	Racial Practices in the Americas Today

A learning module consisted of weekly PowerPoint presentation, discussion forums, resources, reading material, and assessments (Figure 3). Week 1 offered a PowerPoint presentation on race, a discussion forum assignment, and PDF and video resources on race. Subsequent weekly chapters followed similar formats.

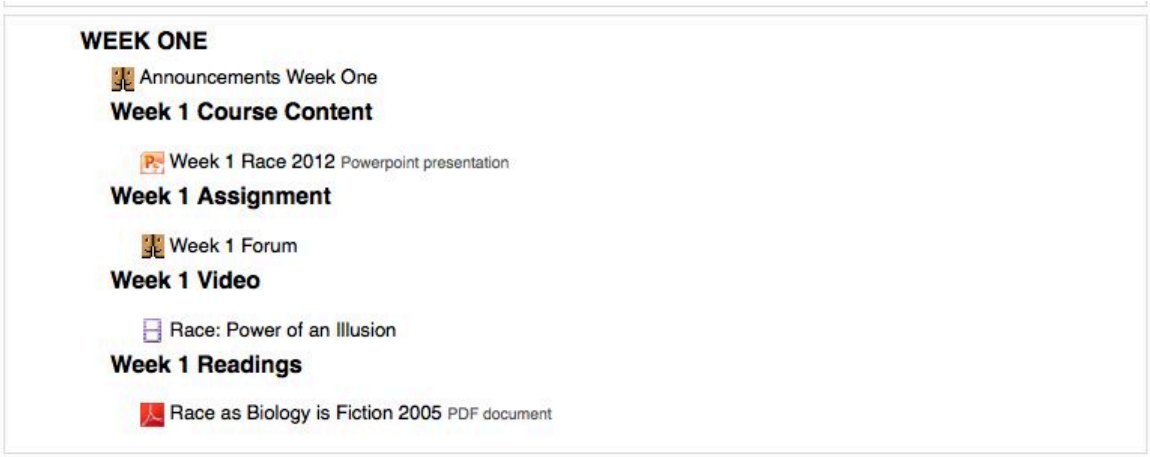

Figure 3. Overview page of online Race and Culture of the Americas course interface depicting a sample of weekly course format.

Course requirements for the online Race and Culture of Americas course consisted of multiple activities with varying point values (Table 5), such as posting on discussion forums for a total of 120 points, online quizzes for a total of 60 points, an online midterm and final examination worth 60 points each. Students could earn a total of 300 possible points.

Table 5

Total Possible Points For Online Race and Culture in the Americas Course

Requirement	Points	Total Points
Forum Participation	12 (x10 weeks)	120
5 Quizzes	5 @ 12 points each	60
Midterm	60	60
Final	60	60
Total Possible Points		300

Discussion forum. Forum participation was required in this course; each student was required to post three times each week. Readings from the essays and articles were required before students respond to the forum. Students began with one original post by Thursday of each week so that peers had time to respond to the thread. Each post had to be well developed, at least 10 sentences minimum, using the readings. Two additional replies were required for full credit. Each reply, due by Sunday night, had to be original, and at least five sentences long. Students could earn up to 12 points per week: 6 points for the original post and 3 points for each reply.

Quizzes. Quizzes were based primarily on the readings with some material drawn from the lectures. Students had 30 minutes to complete each quiz. Quizzes included of multiple choice and short answer questions. All quizzes were made available from Friday at 11:00 a.m. to Saturday at 11:00 p.m. There were a total of five quizzes worth 12 points each.

Midterm and final exams. The midterm and final examination were given on the fifth week of the quarter and during finals week, respectively. Exams comprised long essay questions

of varying degrees of difficulty. Approximately 50% of the content came from the lecture and the other 50% came from the reading. Each exam was worth 60 points each.

Human Subjects Considerations

Participants were given an *Informational Cover Letter* that described the purpose, procedures, risks, benefits, and all necessary information related to the study (Appendix A). Each section was explained in detail. Prospective subjects were given the researcher and research assistant's contact information to give them the opportunity to ask questions and receive answers to their satisfaction. Although all students enrolled in the online Natural Disasters course and the online Race and Culture in Americas course were required to participate in all online discussion forums, activities, quizzes, midterm, and final examination as part of the online course requirements, not all students were required to participate in the study. Participation was voluntary. Participants were assured that any information obtained in connection with the study and any information that could potentially identify them would remain confidential. Generic codes in lieu of student names—such as Case 1, Case 2, and Case 3—were assigned during the data collection processing and analysis period for an added layer of confidentiality. Student survey responses, LMS data, and discussion forum posts and replies were kept in a password-protected file on the researcher and research assistant's personal computers. Course grades were not influenced by whether a student agreed or declined to participate in the study. Students were notified that they could withdraw from the study at any time.

This study was submitted to CSULA's Institutional Review Board (IRB) as expedited research (see Appendix B). The proposed research involved survey research with an adult population that was not a protected group. The survey did not ask for identifying information that directly linked the information back to the participants. Codes were used to link students'

achievement of course objective scores with survey responses and LMS data for collection and analysis purposes only, but identifiers or other identifying information were not used in any part of this study, and will not be used in future publications or presentations. The study presented minimal risks to the participants and disclosure of data outside the study will not place the participants at risk of criminal or civil liability or damage their financial standing, employability, or reputation.

Instrumentation and Data Collection Procedures

Online Student Engagement Survey (OSES). The OSES (see Appendix E), developed and validated by Marcia Dixson (2010), was used with the author's permission (Appendix F) to measure students' perceived level of engagement in an online course. To create the OSES, Dixson used Handelsman, Briggs, Sullivan, and Towler's (2005) Student Course Engagement Questionnaire (SCEQ) as a foundation because of its four factors of skills engagement, emotional engagement, participation/interaction engagement, and performance engagement. These four subcategories closely reflect past empirical studies on student engagement and motivation (Fredricks et al., 2004; Skinner & Belmont, 1993). Dixson used a focus group of online instructors to list what an engaged online student *looked like* in terms of the four factors. The results of the focus group were used to adapt the SCEQ into the OSES, which retained the four subcategories of skills engagement, emotional engagement, participation engagement, and performance engagement (see Table 6).

The OSES, a self-report instrument where respondents indicate their level of agreement with 19 statements using a 5-point Likert-style scale, was used to measure the extent of a students' engagement in an online college course. Student responses were rated on a scale of 0 (not at all characteristic of me) to 4 (very characteristic of me) producing a total numeric value

ranging from 0 to 76. Each subcategory yielded its own numeric value; skills engagement contained six items and produced a numeric value ranging from 0 to 24, emotional engagement contained five items and produced a numeric value ranging from 0 to 20, participation engagement contained six items and produced a numeric value of 0 to 24, and performance engagement contained two items and produced a numeric value of 0 to 8.

Table 6

The OSES and Four Subcategories

Skills Engagement	Emotional Engagement	Participation Engagement	Performance Engagement
Studying regularly	Putting forth effort	Having fun online	Getting good grades
Staying up on the readings	Making the course relevant	Active in discussions	Doing well on tests
Reviewing notes	Applying to life	Helping students	
Being organized	Making course interesting	Engaging in online Conversations	
Taking good notes	Desiring to learn	Posting on discussion forums	
Listening/reading carefully		Getting to know other students	

This particular instrument was chosen because it focused on student engagement in an online course. Focusing on engagement at the course level allows educators to "have the most control and could make the most—or at least the most immediate—difference (Handelsman et al., 2005, p. 185).

Reliability. Marcia Dixson (2010) tested the OSES's reliability on a pilot group of 31 online students. Evaluation of the instrument was correlated with a 0.95 reliability score.

Validity. The OSES supported face validity by correlating strongly with two global items on engagement with the course ($r = 0.73$; $p < 0.01$). Of the original 30 items, 19 items loaded onto the four pre-determined factors: skills engagement, emotional engagement, participation engagement, and performance engagement. The 19 items yielded a Cronbach alpha of 0.91 and significantly correlated with the global course of engagement item ($r = 0.67$; $p < 0.001$).

Data collection procedures. Three data collection sources were used for this study: web-based questionnaire, extracted LMS data related to students' online activities, and achievement of course objectives by aggregating percentage scores of students' online course requirements and assessments.

After receiving approval from the IRB for CSULA (Appendix B) and entering into a cooperative agreement with Pepperdine University (Appendix C), a research assistant sent an informational cover letter to students who were enrolled in the Natural Disasters or the Race and Culture in the Americas online courses via email to participate in the study during the 10th week of the quarter. Two follow-up emails using the same information cover letter were sent during finals week and one week after the quarter had ended. The informational cover letter contained background information of the research study, such as purpose, procedures, risks and benefits for participating in the study, and survey instructions for students. A URL link was provided within the invitation, which took students directly to the survey. The survey consisted of two parts. Part 1 of the survey included the demographic questions, such as age, gender, ethnicity, unit load, GPA, highest educational goal, number of hours worked outside the home, number of online courses taken, enjoyment level of online courses, and ability and confidence of online learning (Appendix D). Part 2 of the survey consisted of the 19-item OSES survey. Results of the survey

were aggregated and uploaded into a password-protected, student-level Excel spreadsheet and held by the research assistant until 2 weeks after final grades were posted.

Existing LMS data for the study were retrieved retroactively and obtained by the research assistant 2 weeks after final grades were submitted to the Registrar's Office. By logging on to the online course and visiting the LMS's Report Logs, the research assistant was able to retrieve required LMS data, such as frequency of logins, frequency of page visits, and frequency of discussion forum views, posts, and replies. Existing LMS data were then transferred onto the same Excel worksheet that contains students' survey results.

Finally, students' achievement of course objectives score was determined from select assignments and assessments. This was done retroactively and obtained 2 weeks after final grades were submitted to the Registrar's Office. Students' achievement of course objective scores and existing LMS data were completed by the research assistant and uploaded to the student-level Excel spreadsheet that contained students' survey results. Individual students' LMS data results and achievement scores corresponded to students' survey results by the research assistant. Codes were assigned (e.g., case 1, case 2, case 3, etc.) in lieu of any identifier, student name, or information that could have linked a student to his/her data on the student-level Excel worksheet, at which point the worksheet was given to the researcher for further analyses. The research assistant stored all data material in a password-protected file on a private, secured computer. Once the research assistant created codes in lieu of any student names and transferred the student-level Excel sheet to the researcher, all materials linking student names with their data were be destroyed.

Proposed Data Analysis Techniques

The purpose of this study was to determine whether relationships exist between students' perceived level of engagement and actual levels of engagement as measured by an LMS of an online course, and between perceived and actual levels of engagement and students' success.

The guiding research questions were initially introduced in Chapter 1 and are revisited again here. Research question #1 asked, What is the relationship between students' perceived level of engagement and students' actual level of engagement as measured by an LMS? The research question was followed up with five sub-questions that examined the relationship between students' perceived level of engagement and frequency of logins, frequency of page visits, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies. Students' perceived level of engagement was measured using the OSES instrument with the author's permission. Total engagement scores and scores for engagement subcategories (skills engagement, emotional engagement, participation engagement, and performance engagement) were aggregated to yield numeric values. These results were correlated with frequency counts obtained from the LMS database (see Table 7).

Research question #2 asked, What is the relationship between students' perceived level of engagement and student success? Students' perceived level of engagement was measured using the OSES instrument. Total engagement score and subcategory scores were aggregated to yield numeric values. Student success was determined by measuring students' achievement of course objectives (see Table 8). Select assignments and assessments were compared to possible learning outcomes.

Research question #3 asked, What is the relationship between students' actual level of engagement as measured by an LMS and student success? The research question was followed

up with five sub-questions that examined the relationship between students' frequency of logins, frequency of page visits, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies and students' success rates. Frequency counts obtained from the LMS database were correlated with student success rates (see Table 9). Aggregated student scores were obtained by examining whether students completed select requirements of online discussion forum posts, online activities, and assessment scores. Summing students' achievement scores was transformed into percentages by dividing points earned by the total points possible.

Table 7

Research Question #1: Sub-questions, Variable Names, Instrument, and Levels of Measurement

#	Research Sub-question	Variable Name	Instrument Name	Level of Measurement
1a	What is the relationship between students' perceived level of engagement and frequency of student logins on an LMS?	Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
		Frequency of logins	LMS data	Total number of student logins
1b	What is the relationship between students' perceived level of engagement and frequency of page visits on an LMS?	Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
		Frequency of page visits on an LMS	LMS data	Total number of page visits
1c	What is the relationship between students' perceived level of engagement and frequency of discussion forum views?	Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
		Frequency of discussion forum views	LMS data	Total number of discussion forum views
1d	What is the relationship between students' perceived level of engagement and frequency of original discussion forum posts?	Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
		Frequency of original discussion forum posts	LMS data	Total number of discussion forum posts
1e	What is the relationship between students' perceived level of engagement and frequency of discussion forum replies?	Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
		Frequency of discussion forum replies	LMS data	Total number of discussion forum replies

Table 8

Research Question #2: Variable Names, Instrument, and Levels of Measurement

Variable Name	Instrument Name	Level of Measurement
Students' perceived levels of engagement	OSES	Total OSES and subcategories scores ranging from 0-76, numeric/ratio
Student Success	Aggregated student scores converted to percentage mark	Students' final percentage score

Table 9

Research Question #3: Sub-questions, Variable Names, Instrument, and Levels of Measurement

#	Research Sub-question	Variable Name	Instrument Name	Level of Measurement
2a	What is the relationship between students' frequency of student logins on an LMS and students' success in the course?	Frequency of logins	LMS data	Total number of student logins
		Student success	Aggregated student scores converted to percentage mark	Students' final percentage score
2b	What is the relationship between students' frequency of page visits on an LMS and students' success in the course?	Frequency of page visits on an LMS	LMS data	Total number of page visits
		Student success	Aggregated student scores converted to percentage mark	Students' final percentage score
2c	What is the relationship between students' frequency of discussion forum views and students' success in the course?	Frequency of discussion forum views	LMS data	Total number of discussion forum views
		Student success	Aggregated student scores converted to percentage mark	Students' final percentage score
2d	What is the relationship between students' frequency of original discussion forum posts and students' success in the course?	Frequency of original discussion forum posts	LMS data	Total number of discussion forum posts
		Student success	Aggregated student scores converted to percentage mark	Students' final percentage score
2e	What is the relationship between students' frequency of discussion forum replies and students' success in the course?	Frequency of discussion forum replies	LMS data	Total number of discussion forum replies
		Student success	Aggregated student scores converted to percentage mark	Students' final percentage score

Proposed data analysis. This section describes in detail the treatment and analyses of collected data. In addition to summarizing demographic questions, methods of data analyses are outlined below, addressing each individual research questions:

Demographic data. Descriptive statistics were used to summarize the sample of the study. Frequency counts, cumulative counts, percentages, and cumulative percentages were calculated for age, gender, ethnicity, highest educational goal, number of units taken, GPA, number of online courses taken, and number of hours worked outside the home. Frequency counts, percentages, mean, and standard deviations were obtained for enjoyment of online learning and confidence in abilities with online technologies.

Research questions. For research question #1, the researcher determined whether a relationship existed between students' perceived level of engagement and students' actual level of engagement as measured by the LMS. Specifically, correlations between students' OSES results (total OSES score and total subcategory scores) and students' LMS data (frequencies of logins and page visits, and frequency of discussion forum views, posts, and replies) were examined. The following statistical analyses were performed on the variables:

1. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for the total score of the OSES instrument and scores for each subcategory: skills engagement, emotional engagement, participation engagement, and performance engagement (dependent variable [DV], numeric).
2. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for frequency of logins, frequency of total page visits, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies (independent variable [IV], numeric).

3. Because both the dependent and independent variables had numeric levels of measurements, *regression analyses* were employed to determine whether significant relationships existed between students' perceived level of engagement and students' actual levels of engagement as measured by the LMS. Correlations were determined by setting alpha to 0.05 initially, and then to 0.10 and 0.01. R^2 values were used to determine the percentage of variation that can be accounted for between variables. The *r*-values were used to determine the strength of the relationships and whether positive or negative relationships existed between variables.

For research question #2, the researcher determined whether relationships existed between students' perceived level of engagement and student success in an online course. Specifically, correlations between students' OSES results (total OSES score and total subcategory scores) and student success (achievement of course objectives) were examined.

1. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for frequency of logins, frequency of total page visits, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies (IV, numeric).
2. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for students' achievement of course objectives (DV, numeric).
3. Because both the dependent and independent variables had numeric levels of measurements, *regression analyses* were employed to determine whether significant relationships existed between students' perceived level of engagement and student success. Correlations were determined by setting alpha to 0.05 initially and then to 0.10 and 0.01. R^2 values were used to determine the percentage of variation that can

be accounted for between variables. The r-values were used to determine the strength of the relationships and whether positive or negative relationships existed between variables.

For research question #3, the researcher determined whether relationships existed between students' actual level of engagement as measured by an LMS and student success in an online course. Specifically, correlations between students' LMS data (frequencies of logins and page visits, and frequency of discussion forum views, posts, and replies) and student success (achievement of course objectives) were examined. The following statistical analyses were performed on the variables:

1. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for students' achievement of course objectives (DV, numeric).
2. Means, medians, modes, standard deviations, ranges, and coefficient of skewness were computed for frequency of logins, frequency of total page visits, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies (IV, numeric).
3. Because both the dependent and independent variables had numeric levels of measurements, *regression analyses* were employed to determine whether significant relationships existed between students' perceived level of engagement and student success. Correlations were determined by setting alpha to 0.05 initially and then to 0.10 and 0.01. R^2 values were used to determine the percentage of variation that can be accounted for between variables. The r-values were used to determine strength of relationships and whether positive or negative relationships existed between variables.

This exploratory study employed inferential statistics to assess relationships between student engagement perceptions and student success using a non-random sample. To conduct inferential statistics random sampling was required. As such, in the absence of a random sample, any generalization to a population should be done with caution and used only to gain insight to guide future research in this field.

Chapter Summary

This initial exploratory study sought to determine whether relationships exist between students' perceived level of engagement and actual levels of engagement as measured by an LMS of an online course, and perceived and actual levels of engagement and student success. Students' perceived level of engagement was measured using Marcia Dixson's (2010) OSES instrument, actual level of engagement was measured by extracting select LMS data, and student success was measured by aggregating assignments and assessments to yield an achievement score of course objectives. Type and strength of relationships have been determined by correlation and regression analyses. Additionally, descriptive statistics were used to characterize the sample of the study. The results of the study, including a summary of the data findings, are reported in Chapter 4. In Chapter 5, major findings are summarized followed by a detailed discussion, conclusion, and recommendations for future research.

Chapter 4: Findings

Introduction

Administrators and educators have long understood the importance of student engagement and its relationship to student success. Student engagement is measured by the amount of time and effort a student puts forth in academically purposeful activities, such as studying, participating in class discussions, and interacting with peers. LMSs are capable of measuring how students engage with educational content by tracking the number of times a student logs in and visits various pages. LMSs can also measure how students engage with others in the course by documenting the number of times a student views, posts, and replies to others on discussion forums. Students' perception of their level of engagement is also important because students who are aware of their level of engagement compared to levels measured by the LMS can monitor their progress and avoid failing a course. The purpose of this initial exploratory study was to determine whether relationships exist between students' perceived level of engagement in a course and students' actual level of engagement as measured by an LMS, students' perceived level of engagement and student success, and students' actual level of engagement and student success.

This chapter describes the data collection procedures used in this study and presents the research findings in three sections. The first section uses descriptive statistics to describe the participants' demographics. The second section examines the study's three variables: students' perceived level of engagement, students' actual level of engagement as measured by an LMS, and student success as measured by students' final percentage score for the course. The third section employs inferential statistics to answer the study's three guiding research questions using correlation and regression analyses to determine whether relationships exist between students'

perceived levels of engagement, students' actual levels of engagement as measured by an LMS of an online course, and student success.

Data Collection Procedures

Three datasets were obtained for this study: web-based OSES, extracted LMS data related to students' online activities, and student success as measured by students' final course percentage score.

After receiving approval from CSULA's IRB and entering into a cooperative agreement with Pepperdine University, an informational cover letter was sent to students to invite them to participate in this initial exploratory study during the 10th week of the quarter. Follow-up letters were sent during finals week and 1 week after the quarter ended. The informational cover letter described the purpose, procedures, risks and benefits for participating in the study, and provided the researcher's contact information. A URL link was provided within the invitation, which took students directly to the survey.

The survey consisted of two parts. The first part included demographics questions: age, gender, ethnicity, unit load, highest educational goal, number of hours worked outside the home, number of online courses taken, enjoyment level of online courses, and ability and confidence of online learning. The second part consisted of the 19-item OSES survey.

Existing LMS data were retrieved retroactively for the study. Two weeks after grades were submitted to the Registrar's Office, the research assistant extracted LMS data, correlated students' achievement scores, and assigned generic codes in lieu of student names before providing the recorded data on an Excel sheet to the researcher.

Demographics: Descriptive Analysis

In this initial exploratory study, 40 respondents participated in the study; 38 actually completed the questionnaire. Demographic questions consisted of age, gender, ethnicity, unit load, GPA, highest educational goal, number of online courses, number of hours worked outside the home, enjoyment of online courses, and ability and confidence in online learning. The tables presented subsequently provide count, cumulative, count, percentage, and cumulative percentage statistics.

Study population by age. Of the 38 respondents, the majority of the students (92.1%, $N = 35$) were in the 18-24 year old age range. Two students (5.3%, $N = 2$) were in the 25-32 year old age range, 1 student (2.6%, $N = 1$) was in the 35-40 year old age range, and no students (0%) were less than 18 years of age or greater than 40 years of age. Table 10 represents the age distribution of the study population.

Table 10

Study Population by Age

Age	Count	Cumulative Count	%	Cumulative %
Less than 18	0	0	0.0	0.0
18-24	35	35	92.1	92.1
25-32	2	37	5.3	97.4
35-40	1	38	2.6	100.0
Greater than 40	0	38	0.0	100.0

Study population by gender. All 38 respondents reported their gender. The majority of the respondents were female (76.3%, $N = 29$) while males accounted for almost one-fourth of the sample (23.7%, $N = 9$). Table 11 represents the gender breakdown of the participants.

Table 11

Study Population by Gender

Gender	Count	Cumulative Count	%	Cumulative %
Male	9	9	23.7	23.7
Female	29	38	76.3	100.0

Study population by ethnicity. All 38 respondents reported their ethnicity. The largest ethnic group who participated in the study was the Latin/Chicano/Hispanic subgroup (74.0%, $N = 28$). The second largest ethnic subgroup was Black (11.0%, $N = 4$), followed by White (7.0%, $N = 3$), Asian/Pacific islander (5.0%, $N = 2$), and then Filipino (19.0%, $N = 1$). Table 12 represents the ethnicity breakdown for the participants.

Table 12

Study Population by Ethnicity

Ethnicity	Count	Cumulative Count	%	Cumulative %
Asian/Pacific Islander	2	2	5.0	5.0
Black	4	6	11.0	16.0
Filipino	1	7	3.0	19.0
Latin/Chicano/Hispanic	28	35	74.0	93.0
Native American	0	35	0.0	93.0
White	3	38	7.0	100.0

Study population by units taken while enrolled in online course. All 38 respondents reported the number of units taken while enrolled in the online course. The majority of the students carried 9-12 units (65.8%, $N = 25$) during the spring 2013 quarter. Approximately one-fourth of the students (29.0%, $N = 11$) were enrolled in 13-16 units, followed by a fraction of the students (2.6%, $N = 1$) enrolling in 5-8 units and (2.6%, $N = 1$) enrolling in just the online course with four units only, and no students (0%) enrolled in 17 units or more for the spring 2013 quarter. Table 13 summarizes the unit breakdown for respondents.

Table 13

Study Population by Units Taken while Enrolled in Online Course

Units	Count	Cumulative Count	%	Cumulative %
4 units	1	1	2.6	2.6
5-8 units	1	2	2.6	5.2
9-12 units	25	27	65.8	71.0
13-16 units	11	38	29.0	100.0
17 or more units	0	38	0	100.0

Study population by estimated GPA. All 38 respondents reported their estimated GPA. Data indicated that the majority of students (39.5%, *N* = 15) estimated their current GPA to be in the 2.5-2.9 range. Approximately one-fourth of the students (23.7%, *N* = 9) estimated their GPA to be in the 3.0-3.5 range, roughly one-fifth of the students (18.4%, *N* = 7) estimated their GPA to be in the 2.0-2.4 range, fewer students (15.8%, *N* = 6) estimated their GPA to be in the 3.5-23.9 range, a single student (2.6%, *N* = 1) estimated their GPA to be less than 2.0, and no students (0%) estimated their GPA to be 4.0. Table 14 summarizes the estimated GPA breakdown for all respondents.

Table 14

Study Population by Estimated GPA

GPA	Count	Cumulative Count	%	Cumulative %
Less than 2.0	1	1	2.6	2.6
2.0-2.4	7	8	18.4	21.0
2.5-2.9	15	23	39.5	60.5
3.0-3.4	9	32	23.7	84.2
3.5-3.9	6	38	15.8	100.0
4.0	0	38	0.0	100.0

Study population by highest educational goal. All 38 respondents reported their highest educational goal with the largest number of students (52.6%, *N* = 20) reported aspirations to complete a master's degree. Approximately one-third of the students (31.6%, *N* = 12) reported aspirations to complete a B.A. or B.S. degree, and fewer students (15.8%, *N* = 6) reported

aspirations to complete a doctoral degree. No students (0%) reported that their highest educational goal was to complete some classes or obtain an A.A. or an A.S. degree. Table 15 represents the educational goal breakdown for participants.

Table 15

Study Population by Highest Educational Goal

Educational Goal	Count	Cumulative Count	%	Cumulative %
To complete some classes	0	0	0.0	0.0
To complete an A.A. or A.S.	0	0	0.0	0.0
To complete a B.A. or B.S.	12	12	31.6	31.6
To complete a master's degree	20	32	52.6	84.2
To complete a doctoral degree	6	38	15.8	100.0

Study population by number of online classes taken. All 38 respondents reported the number of online courses they have taken so far, with the largest number of students (44.7%, $N = 17$) currently taking their first online course by reporting one online class. Nearly one-third of the students (29.0%, $N = 11$) have taken two online classes, a few students (10.5%, $N = 4$) have taken three online classes and (10.5%, $N = 4$) have taken five or more online classes, and a small number of students (5.3%, $N = 2$) have taken four online classes. Table 16 summarizes the number of online classes taken breakdown for the study's participants.

Table 16

Study Population by Number of Online Classes Taken

Online Classes	Count	Cumulative Count	%	Cumulative %
One online class	17	17	44.7	44.7
Two online classes	11	28	29.0	73.7
Three online classes	4	32	10.5	84.2
Four online classes	2	34	5.3	89.5
Five or more online classes	4	38	10.5	100.0

Study population by number of hours worked. All 38 respondents reported the number of hours worked outside the home; the largest number of students (26.3%, $N = 10$) reported

working 1-10 hours per week. Approximately one-fourth of the students (23.7%, *N* = 9) reported working 21-30 hours per week, fewer students (21.1%, *N* = 8) reported working 0 hours per week, even fewer students (10.5%, *N* = 4) reported working 11-20 hours per week or 40 hours or more per week (10.5%, *N* = 4), and only a few students (7.9%, *N* = 3) reported working 31-40 hours per week. Table 17 represents the breakdown for the number of hours students worked per week.

Table 17

Study Population by Number of Hours Worked

Hours Worked	Count	Cumulative Count	%	Cumulative %
0 hours per week	8	8	21.1	21.1
1-10 hours per week	10	18	26.3	47.4
11-20 hours per week	4	22	10.5	57.9
21-30 hours per week	9	31	23.7	81.6
31-40 hours per week	3	34	7.9	89.5
40 hours or more per week	4	38	10.5	100.0

Study population by enjoyment of online learning and confidence. All 38 respondents reported their online learning enjoyment and their confidence in their ability with online technology. Response rates for online learning enjoyment indicated that the majority of respondents (63.2%, *N* = 24) either agreed (36.9%, *N* = 14) or strongly agreed (26.3%, *N* = 10) that they enjoy online learning. A few (10.5%, *N* = 4) of the students did not enjoy online learning and stated that they either disagreed (2.6%, *N* = 1) or strongly disagreed (7.9%, *N* = 3). Approximately one-quarter (26.3%, *N* = 10) of the students neither agreed nor disagreed that they enjoyed online learning. Similarly, response rates for confidence in abilities with online technology indicated that the majority of respondents (63.2%, *N* = 24) either agreed (29.0%, *N* = 11) or strongly agreed (34.2%, *N* = 13), fewer students (18.4%, *N* = 7) were not confident in their abilities with online technology and stated that they either disagreed (10.5%, *N* = 7) or

strongly disagreed (7.9%, $N = 4$), and just under one-fifth of the students (18.4%, $N = 7$) neither agreed nor disagreed that they were confident in their abilities with online technology. Table 18 represents the breakdown of students' enjoyment of online learning and confidence in their abilities with online technology.

Table 18

Study Population by Enjoyment of Online Learning and Confidence in Ability

Statement	1 Strongly Disagree	2 Disagree	3 Neither Agree nor Disagree	4 Agree	5 Strongly Agree	*N*	Mean	SD
I enjoy online learning	3 (7.9%)	1 (2.6%)	10 (26.3%)	14 (36.9%)	10 (26.3%)	38	3.71	1.14
I am confident of my abilities with online technology	3 (7.9%)	4 (10.5%)	7 (18.4%)	11 (29.0%)	13 (34.2%)	38	3.71	1.27

Description of Variables

Three datasets were collected for this study: students' perceived level of engagement, students' actual level of engagement, and student success. Students' perceived level of engagement was determined using Marcia Dixon's (2010) OSES. Students' actual level of engagement was determined by extracting select LMS data, such as frequency of logins, frequency of page visits (number of page visits per login, resource views, user views, quiz view, quiz review views, discussion forum views), and frequency of discussion forum views, posts, and replies. Student success was determined by dividing students' actual points earned by total possible points multiplied by 100, which resulted in a final percentage score for the course.

Students' perceived level of engagement. Students' perceived level of engagement was measured by student responses to the OSES. The OSES was created and validated by Marcia Dixon (2010) and used with her permission. Students self-report perceived levels of engagement

by responding to a 19-item questionnaire with Likert-type response scores ranging from 0 (not at all characteristic of me) to 4 (very characteristic of me). The OSES contains four subcategories: skills engagement, emotional engagement, participation engagement, and performance engagement. Skills engagement includes questions on how students interact with the course content, such as studying regularly and staying up with the readings. Emotional engagement includes questions on how students make the course content relevant, interesting and useful, such as applying course material to their everyday lives. Participation engagement includes questions on how students interact with others, such as participating online by posting questions on discussion forums and helping other students. Performance engagement includes questions on how well students perform in class, such as getting good grades and doing well on exams. Response rates yielded a total average numeric value ranging from 0 to 76 on the OSES and an average score for each of the four subcategories. Skills engagement and participation engagement included six questions each, yielding an average score ranging from 0-24 for each subcategory. Emotional engagement included five questions yielding an average score ranging from 0-20, and performance engagement includes two questions yielding an average score ranging from 0-8. Table 19 summarizes students' perceived level of engagement with the number of responses (*N*), minimum value (Min.), maximum value (Max.), mean, median, mode, standard deviation (*SD*), and skewness for total engagement scores and its four subcategories: skills engagement, emotional engagement, participation engagement, and performance engagement.

Table 19

Descriptive Statistics for Students' Perceived Level of Engagement

Variable	*N*	Range	Mean	Median	Mode	SD	Skewness
Total Engagement	38	11-76	52.95	54.00	54.00	13.648	-.771
Skills Engagement	38	5-24	17.58	18.00	18.00	4.624	-.647
Emotional Engagement	38	0-20	14.74	15.00	16.00	3.943	-1.395
Participation Engagement	38	1-24	13.82	14.50	18.00	6.075	-.397
Performance Engagement	38	4-8	6.82	8.00	8.00	1.392	-.731

Total online student engagement scores were summed values from the aforementioned four sub-categories with a possible range from 0 to 76. The mean total engagement score was 52.95 with a standard deviation of 13.65. This meant that if all the respondents had the same total engagement score, they would have scored 52.95 with a + or - variation of 13.65. The mode was 54; therefore, the most common total engagement response score was 54. The median total engagement score was 5, which meant that half of the respondents reported values 54 or less and the other half of the respondents reported values 54 or more. The range of total engagement scores was 65. This meant that 65 points separated the highest total engagement score of 76 and the lowest total engagement score of 11. The coefficient of skewness was -0.771, which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Skills engagement scores reflected responses to six questions and ranged from 0 to 24. The mean skills engagement score was 17.58 with a standard deviation of 4.624. This meant that if all the respondents had the same skills engagement score, they would have score 17.58 with a + or - variation of 4.624. The mode was 18.00; therefore, the most common skills engagement response score was 18.00. The median skills engagement score was 18.00, which meant that half of the respondents reported values 18.00 or less and the other half of the respondents reported values 18.00 or more. The range of skills engagement scores was 19. This means that 19 points

separated the highest skills engagement score of 24 and the lowest skills engagement score of 5. The coefficient of skewness was -.647, which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Emotional engagement scores contained five questions and ranged from 0 to 20. The mean emotional engagement score was 14.74 with a standard deviation of 3.943. This meant that if all the respondents had the same emotional engagement score, they would have scored 14.74 with a + or - variation of 3.943. The mode was 15.00; therefore, the most common emotional engagement response score was 15.00. The median emotional engagement score was 16.00, which meant that half of the respondents reported values 16.00 or less and the other half of the respondents reported values 16.00 or more. The range of emotional engagement scores was 20. This meant that 20 points separated the highest emotional engagement score of 20 and the lowest emotional engagement score of 0. The coefficient of skewness was -1.395, which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Participation engagement scores reflected responses to six questions and ranged from 0 to 24. The mean participation engagement score was 13.82 with a standard deviation of 6.075. This meant that if all the respondents had the same participation engagement score, they would have scored 13.82 with a + or - variation of 6.075. The mode was 18.00; therefore, the most common participation engagement response score was 18.00. The median participation engagement score was 14.50, which meant that half of the respondents reported values 14.50 or less and the other half of the respondents reported values 14.50 or more. The range of participation engagement scores was 23. This meant that 23 points separated the highest participation engagement score of 24 and the lowest emotional engagement score of 1. The coefficient of skewness was -.397,

which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Performance engagement scores reflected responses to two questions and ranged from 0 to 8. The mean performance engagement score was 6.82 with a standard deviation of 1.392. This meant that if all the respondents had the same performance engagement score, they would have scored 6.82 with a + or - variation of 1.392. The mode was 8.00; therefore, the most common performance engagement response score was 8.00. The median performance engagement score was also 8.00, which meant that half of the respondents reported values 8.00 or less and the other half of the respondents reported values 8.00 or more. The range of performance engagement scores was 4. This meant that 4 points separated the highest performance engagement score of 8 and the lowest performance engagement score of 4. The coefficient of skewness is was -.731, which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Table 20 displays the OSES total engagement scores, the frequency (count) of each score, cumulative count, percentage, and cumulative percentage. The OSES total engagement scores had a 65-point range. This meant that 65 points separated the highest total engagement score of 76 from the lowest total engagement score of 11. Because of the small sample size, frequency counts ranged from 1 to 3. Four total engagement scores that resulted in 32, 54, 59, and 76 values had the highest occurrence rates tallying 3 counts each. Six total engagement scores that resulted in 41, 46, 47, 50, 52, and 29 valued had the second highest occurrence rates tallying 2 counts each. The remainder 17 total engagement scores listed had occurrence rates of 1 count each. Total engagement scores not listed had an occurrence rate of 0.

Table 20

Frequency of Students' Perceived Level of Engagement Total Engagement Score

OSES Total Engagement Score	Count	Cumulative Count	%	Cumulative %
11	1	1	2.6	2.6
25	1	2	2.6	5.3
32	1	3	2.6	7.9
33	1	4	2.6	10.5
40	1	5	2.6	13.2
41	2	7	5.3	18.4
46	2	9	5.3	23.7
47	2	11	5.3	28.9
48	1	12	2.6	31.6
49	1	13	2.6	34.2
50	2	15	5.3	39.5
51	1	16	2.6	42.1
52	2	18	5.3	47.4
54	3	21	7.9	55.3
55	1	22	2.6	57.9
56	1	25	2.6	60.5
59	3	26	7.9	68.5
60	1	28	2.6	71.1
61	2	29	5.3	76.3
62	1	30	2.6	78.9
63	1	31	2.6	81.6
64	1	32	2.6	84.2
66	1	33	2.6	86.8
67	1	34	2.6	89.5
69	1	35	2.6	92.1
76	3	38	7.9	100.0

Students' actual level of engagement. Students' actual level of engagement was determined retroactively by extracting five datasets from the course's Moodle LMS. Two of the five datasets were extracted and analyzed from the entire course log sheets, which included frequency of total logins and frequency of page visits. The remaining three datasets were retrieved from the discussion forum logs, which included frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies.

Discussion forum views were measured by the number of times a student visited a discussion forum page but did not necessarily contribute to the forum. Discussion forum posts were measured as original threads that initiated a topic for discussion. Discussion forum replies were measured as responses to either an original post or a secondary reply and did not initiate a topic for discussion. Frequency data were numeric variables on a ratio level of measurement.

Frequency of logins was defined by the number of times a student first logged into the LMS. Initial logins were measured determined by extracting LMS data and downloading as an Excel spreadsheet, which was scanned for changes in date, changes in the Internet Protocol (IP) listed, and items that had greater than 1-hour time lapses from one login to the next. Every date change, IP protocol change, and greater than 1-hour lapse was counted as 1 login.

The frequency of page visits was measured by determining the average number of page visits per login and by calculating the number of times a student visits a particular page. Average number of page visits was calculated by dividing the total number of items logged by the frequency of logins. Higher numbers represented more pages visits per login. Lower numbers represented less page visits per login.

There were various pages within the Moodle LMS, but page visits used for this study were pages common to the online courses studied, such as resource page, user page, discussion forum page, and quiz page. Therefore, frequency of page visits included frequency of resource views, frequency of user views, frequency of quiz views, frequency of quiz review views, and frequency of discussion forum home page views. A resource was defined as an item that provides students with information related to course material. Examples of resources included PowerPoints, PDFs, Word documents, webpages, and videos. Sorting the LMS Excel log sheet and counting the number of resource views determined frequency of resource views. User view

was the number of times a student visited another user's profile. In other words, LMS log sheets documented the number of times a student visited an enrolled user's profile page. The profile page contained the enrolled user's picture, personal summary, and contact information. All students enrolled in the course have a profile page. Forum views reflected the number of times a student visited the home page of a discussion forum. From the course home page, students who clicked on the title of a discussion forum logged a forum home page view count. For example, a main title *Random Thoughts About the Course Readings* may be viewed from the course home page. When students clicked on the title, they saw a list of students' original posts. Quiz view described the number of times a student visited the instruction page of an online quiz and or exam before actually taking the exam. Quiz review view described the number of times a student went back to review a quiz already taken.

Discussion forum views were the number of times a student visited a discussion forum that had an original posting from any member of the course. Discussion forum posts were the number of times a student actually posted an original topic to the discussion forum. Discussion forum replies were the number of times a student replied to an original discussion forum post or a reply to a post.

Table 21 summarizes students' actual level of engagement with the number of responses (*N*), minimum value (Min.), maximum value (Max.), mean, median, mode, standard deviation (*SD*), and skewness for frequency of logins; frequency of page visits (ratio of page visits per login, frequency of resource views, frequency of user views, frequency of quiz views, frequency of quiz review views, and frequency of discussion forum home page views); and frequency of discussion forum views, posts, and replies.

Table 21

Descriptive Statistics on Students' Actual Level of Engagement as Measured by LMS Data

Variable	*N*	Range	Mean	Median	Mode	SD	Skewness
Freq. of Logins	38	28-191	80.21	73.00	39.00	37.340	.984
Ratio of Page Views/Login	38	4-43	19.35	18.65	4.45	8.260	.673
Freq. of Resource Views	38	18-213	83.71	79.50	57.00	38.665	1.305
Freq. of User Views	38	1-57	14.84	11.00	3.00	13.153	1.295
Freq. of Quiz Views	38	21-134	63.03	57.00	27.00	31.140	.717
Freq. of Quiz Reviews	38	0-378	77.65	53.00	0.00	85.720	1.686
Freq. of Forum Home Views	38	51-668	248.16	234.00	215.00	137.682	1.136
Freq. of Forum Views	38	29-483	200.74	187.50	29.00	118.474	.762
Freq. of Forum Posts	38	0-31	13.16	10.00	10.00	7.621	.872
Freq. of Forum Replies	38	1-50	20.37	17.50	16.00	11.129	.596

The frequency of logins, or the number of initial logins, for the 38 respondents ranged from 28 to 191. The mean frequency of logins was 80.21 with a standard deviation of 37.340. This meant that if all the respondents had the same frequency of logins, they would have scored 80.21 with a + or - variation of 37.40. The mode was 39.00; therefore, the most common login frequency was 8. The median frequency of login was 73.00, which meant that half of the respondents initially logged in 73.00 times or less and the other half of the respondents initially logged in 73.00 times or more. The range of the frequency of logins was 163. This meant that 163 points separated the highest login frequency of 191 and the lowest login frequency of 28. The coefficient of skewness was .984, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

The ratio of page views per login for the 38 respondents ranged from 4 to 43. The mean ratio of page views per login was 19.35 with a standard deviation of 8.260. This means that if all the respondents had the same ratio of page views per login, they would have scored 19.35 with a + or - variation of 8.260. The mode was 4.45; therefore, the most common ratio of page views

per login was 4.45. The median ratio of page views per login was 18.65, which meant that half of the respondents visited 18.65 pages per login or less and the other half of the respondents visited 18.65 pages per login or more. The range of the ratio of page views per login was 39. This meant that 39 points separated the highest ratio of page views per login of 43 and the lowest ratio of page views per login of 4. The coefficient of skewness was .673, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of resource page views, or the number of times a student viewed a resource page, for the 38 respondents ranged from 18 to 213. The mean frequency of resource views was 83.71 with a standard deviation of 38.665. This meant that if all the respondents had the same frequency of resource views, they would have scored 83.71 with a + or - variation of 38.665. The mode was 57.00; therefore, the most common frequency of resource page views was 57.00. The median frequency of resource views was 79.50, which meant that half of the respondents viewed resource pages 79.50 times or less and the other half of the respondents viewed resource pages 79.50 times or more. The range of frequency of resource page views was 195. This meant that 195 points separated the highest frequency of resource page views of 213 and the lowest frequency of resource page views of 18. The coefficient of skewness was 1.305, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of user page views, or the number of times a student viewed a user's profile page, for the 38 respondents ranged from 1 to 57. The mean frequency of user views was 14.84 with a standard deviation of 13.153. This meant that if all the respondents had the same frequency of user's profile page views, they would have scored 14.84 with a + or - variation of 13.153. The mode was 3.00; therefore, the most common frequency of user's profile page views was 3.00. The median frequency of user views was 11.00, which meant that half of the

respondents viewed a user's profile page 11.00 times or less and the other half of the respondents viewed a user's profile page 11.00 times or more. The range of frequency of user's profile page views was 56. This meant that 56 points separate the highest frequency of user's profile page view of 57 and the lowest frequency of user's profile page view of 1. The coefficient of skewness was 1.295, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of quiz views, or the number of times a student viewed a quiz page, for the 38 respondents ranged from 21 to 134. The mean frequency of quiz views was 63.03 with a standard deviation of 31.140. This meant that if all the respondents had the same frequency of quiz page views, they would have scored 63.03 with a + or - variation of 31.140. The mode was 27.00; therefore, the most common frequency of quiz page views was 27.00. The median frequency of quiz views was 57.00, which meant that half of the respondents viewed a quiz page 57.00 times or less and the other half of the respondents viewed a quiz page 57.00 times or more. The range of frequency of quiz page views was 113. This meant that 113 points separated the highest frequency of quiz page views of 134 and the lowest frequency of quiz page views of 21. The coefficient of skewness was .717, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of quiz review page views, or the number of times a student reviewed a quiz page after it had been completed, for the 38 respondents ranged from 0 to 378. The mean frequency of quiz review views was 77.65 with a standard deviation of 85.720. This meant that if all the respondents had the same frequency of quiz review page views, they would have scored 77.65 with a + or - variation of 85.720. The mode was 0; therefore, the most common frequency of quiz review page views was 0. The median frequency of quiz review views was 53.00, which

meant that half of the respondents viewed a quiz review page 53.00 times or less and the other half of the respondents viewed a quiz review page 53.00 times or more. The range of frequency of quiz review page views was 378. This meant that 378 points separated the highest frequency of quiz review page views of 378 and the lowest frequency of quiz review page views of 0. The coefficient of skewness was 1.686, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of discussion forum home views, or the number of times a student viewed a discussion forum home page, for the 38 respondents ranged from 51 to 668. The mean frequency of quiz views was 248.16 with a standard deviation of 137.682. This meant that if all the respondents had the same frequency of discussion forum home page views, they would have scored 248.16 with a + or - variation of 137.682. The mode was 215.00; therefore, the most common frequency of discussion forum home page view was 215.00. The median frequency of discussion forum home page views was 234.00, which meant that half of the respondents viewed a discussion forum home page 234.00 times or less and the other half of the respondents viewed a discussion forum home page 234.00 times or more. The range of frequency of discussion forum home page views was 617. This meant that 617 points separated the highest frequency of discussion forum home page views of 668 and the lowest frequency of discussion forum home page views of 51. The coefficient of skewness was 1.136, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of discussion forum views, or the number of times a student viewed a discussion forum post, for the 38 respondents ranged from 29 to 483. The mean frequency of discussion forum views was 200.74 with a standard deviation of 118.47. This meant that if all the respondents had the same frequency of discussion forum views, they would have viewed the

forums 200.74 times with a + or - variation of 118.47. The mode was 29.00; therefore, the most common frequency of discussion forum views was 29.00. The median frequency of discussion forum views was 187.50, which meant that half of the respondents viewed a discussion forum page 187.50 times or less and the other half of the respondents viewed a discussion forum page 187.50 times or more. The range of frequency of discussion forum home page views was 454. This meant that 454 points separate the highest frequency of discussion forum views of 483 and the lowest frequency of discussion forum views of 29. The coefficient of skewness was .762, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of discussion forum posts, or the number of times a student posted on a discussion forum, for the 38 respondents ranged from 0 to 31. The mean frequency of discussion forum posts was 13.16 with a standard deviation of 7.62. This meant that if all the respondents had the same frequency of discussion forum posts, they would have posted 13.16 times with a + or - variation of 7.62. The mode was 10.00; therefore, the most common frequency of discussion forum posts was 10.00. The median frequency of discussion forum posts was 10.00, which meant that half of the respondents posted on a discussion forum 10.00 times or less and the other half of the respondents posted on a discussion forum 10.00 times or more. The range of frequency of discussion forum posts was 31. This meant that 31 points separated the highest frequency of discussion forum views of 31 and the lowest frequency of discussion forum views of 0. The coefficient of skewness was .872, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Frequency of discussion forum replies, or the number of times a student replied to an original post of discussion forum or a reply to an original post, for the 38 respondents ranged

from 1 to 50. The mean frequency of discussion forum replies was 20.37 with a standard deviation of 11.13. This meant that if all the respondents had the same frequency of discussion forum replies, they would have replied 20.37 times with a + or - variation of 11.13. The mode was 16.00; therefore, the most common frequency of discussion forum replies was 16.00. The median frequency of discussion forum posts was 17.50, which meant that half of the respondents replied to a discussion forum post or reply 17.50 times or less and the other half of the respondents replied to a discussion forum post or reply 17.50 times or more. The range of frequency of discussion forum posts was 49. This meant that 49 points separated the highest frequency of discussion forum replies of 50 and the lowest frequency of discussion forum views of 1. The coefficient of skewness was .596, which indicated an asymmetric distribution with the tail extending towards the right or positively skewed.

Student success. Students' success rates were determined by examining their achievement of course objectives based on total points earned compared to total points possible. Points were earned from a variety of activities, such as completing assignments, posting and replying on discussion forums, and taking online quizzes and exams. Students' percentages were calculated by dividing accumulated points earned by total points possible

Table 22 summarizes students' success scores with the number of responses (*N*), minimum value (Min.), maximum value (Max.), mean, median, mode, standard deviation (Std. Dev.), and coefficient of skewness. Student success scores, or the total points earned divided by the total points possible, for the 38 respondents ranged from 44 to 92. The mean student success score was 76.97 with a standard deviation of 11.33. This meant that if all the respondents had the same student success score, they would have scored 76.97 with a + or - variation of 11.33. The mode was 75.00; therefore, the most common student success score was 75.00. The median

student success score was 76.97, which meant that half of the respondents had a student success score of 76.97 or less and the other half of the respondents had a student success score of 76.97 or more. The range of student success scores was 48. This meant that 48 points separated the highest student success score of 92 and the lowest student success score of 44. The coefficient of skewness was -1.276, which indicated an asymmetric distribution with the tail extending towards the left or negatively skewed.

Table 22

Descriptive Statistics for Students Success

Variable	*N*	Range	Mean	Median	Mode	SD	Skewness
Student Success Scores	38	44-92	76.97	78.00	75.00	11.33	-1.276

Research Questions

To address the research questions in this study, correlation analysis was performed using the aforementioned variables: students' perceived level of engagement (OSES), students' actual level of engagement (LMS data), and student success (final percentage). The overarching research questions and sub-questions were investigated to determine whether relationships existed between the variables. The purpose of the first research question was to determine whether relationships existed between students' perceived level of engagement and students' actual level of engagement. The purpose of the second research question was to determine whether relationships existed between students' perceived level of engagement and student success. The purpose of the third research question was to determine whether relationships existed between students' actual level of engagement and student success.

Research Question #1

What is the relationship between students' perceived level of engagement and students' actual level of engagement as measured by the LMS?

Research sub-question #1a. What is the relationship between students' perceived level of engagement and frequency of student logins in an LMS?

Findings. Table 23 summarizes the findings of the correlation and regression analysis for students' perceived level of engagement (DV) and frequency of logins (IV). The regression equation, $Y = \alpha + \beta X$, models the relationship between two variables by fitting observed data to a straight line. The Y value was perceived level of total engagement (DV) and the X value was frequency of logins (IV). The y-intercept was $\alpha = 44.795$. The regression coefficient (or slope of the line) was $\beta = 0.102$. Therefore, the regression equation was $Y = 44.795 + 0.102X$. The correlation coefficient *r* for the relation between frequency of logins and students' perceived level of engagement was $r(36) = 0.278$ ($p = 0.091$). Taylor (1990) reported that correlation coefficients *r* smaller than +/-0.36 reflect a low or weak relationship. As such, the relationship between frequency of logins and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in students' perceived level of total engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.077$; therefore, 7.7% of the variation in students' perceived level of engagement of their total engagement score (DV) can be accounted for by the variation in frequency of logins (IV). The ratio of the variance that determines whether two variances—perceived level of engagement and frequency of logins—are equal was F-ratio = 3.017 ($p = 0.091$). The F distribution critical value was calculated at $F_{crit} = 1.531$ ($p = 0.10$). Since the F-ratio was greater than the F distribution critical value, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 23

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Logins (IV) and Students' Perceived Levels of Engagement (DV): Total Engagement, and Skills Engagement, Emotional Engagement, Participation Engagement, and Performance Engagement Subcategories

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Total Engmt.	Logins	0.091*	44.795	0.102	0.278	0.077	3.017***
Skills Engmt.		0.046**	14.325	0.040	0.325	0.106	4.260***
Emotional Engmt.		0.249	13.112	0.020	0.192	0.037	1.375
Participation Engmt.		0.267	11.403	0.030	0.185	0.034	1.273
Performance Engmt.		0.072*	5.932	0.011	0.296	0.087	3.446***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for skills engagement the Y value was perceived level of skills engagement (DV), and the X value was frequency of logins (IV). The y-intercept was $\alpha = 14.325$. The regression coefficient (or slope of the line) was $\beta = 0.040$. Therefore, the regression equation was expressed as $Y = 14.325 + 0.040X$. The correlation coefficient *r* for the relation between frequency of logins and students' perceived level of skills engagement was $r(36) = 0.325$ ($p = 0.046$). The relationship between frequency of logins and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.106$; therefore, 10.6% of the variation in students' perceived level of engagement of their skills engagement score (DV) can be accounted for by the variation in frequency of logins (IV). The ratio of the variance that determines whether two variances—skills engagement and frequency of logins—are equal was F-ratio = 4.260 ($p = 0.046$). The F distribution critical value was calculated at $F_{crit} = 1.730$ ($p = 0.05$). Since the F-

ratio was greater than the F distribution critical value at $p = 0.50$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for emotional engagement the Y value was perceived level of emotional engagement (DV), and the X value was frequency of logins (IV). The y-intercept was $\alpha = 13.112$. The regression coefficient (or slope of the line) was $\beta = 0.020$. Therefore, the regression equation was expressed as $Y = 13.112 + 0.020X$. The correlation coefficient *r* for the relation between frequency of logins and students' perceived level of emotional engagement was $r(36) = 0.192$ ($p = 0.249$). The relationship between frequency of logins and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.037$; therefore, 3.7% of the variation in students' perceived level of emotional engagement score (DV) can be accounted for by the variation in frequency of logins (IV). The ratio of the variance that determines whether two variances—perceived level of emotional engagement and frequency of logins—are equal was F-ratio = 1.375 ($p = 0.249$). The F distribution critical value was calculated at $F_{crit} = 1.531$ ($p = 0.10$). Since the F-ratio was less than the F distribution critical value, then the F-ratio was not significant.

Plotting the regression equation for participation engagement the Y value was perceived level of participation engagement (DV), and the X value was frequency of logins (IV). The y-intercept was $\alpha = 11.403$. The regression coefficient (or slope of the line) was $\beta = 0.030$. Therefore, the regression equation was expressed as $Y = 11.403 + 0.030X$. The correlation coefficient *r* for the relation between frequency of logins and students' perceived level of

participation engagement was $r(36) = 0.185$ ($p = 0.267$). The relationship between frequency of logins and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.034$; therefore, 3.4% of the variation in students' perceived level of participation score (DV) can be accounted for by the variation in frequency of logins (IV). The ratio of the variance that determines whether two variances—participation engagement and frequency of logins—are equal was F-ratio = 1.273 ($p = 0.046$). Since the F-ratio was less than the F distribution critical value at $p = 0.05$, then F-ratio was not significant.

Plotting the regression equation for performance engagement the Y value was perceived level of performance engagement (DV), and the X value was frequency of logins (IV). The y-intercept was $\alpha = 5.932$. The regression coefficient (or slope of the line) was $\beta = 0.011$. Therefore, the regression equation was expressed as $Y = 5.9323 + 0.011X$. The correlation coefficient r for the relation between frequency of logins and students' perceived level of performance engagement was $r(36) = 0.296$ ($p = 0.072$). The relationship between frequency of logins and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in students' perceived level of performance engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.087$; therefore, 8.7% of the variation in students' perceived level of performance engagement score (DV) can be accounted for by the variation in frequency of logins (IV). The ratio of the variance that determines whether two variances—performance engagement and

frequency of logins—are equal was F-ratio = 3.446 (p = 0.072). Since the F-ratio was greater than the F distribution critical value at p = 0.10, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research sub-question #1b. What is the relationship between students' perceived level of engagement and frequency of page visits in an LMS?

Findings. Table 24 summarizes the findings when performing correlation and regression analysis for students' perceived level of engagement (DV) and frequency of page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views (IV). The regression equation, $Y = \alpha + \beta X$, models the relationship between two variables by fitting observed data to a straight line. The Y value was students' perceived level of total engagement (DV), and the X values were frequencies of page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views. (IV). The y-intercepts were $\alpha = 50.742$, $\alpha = 51.116$, $\alpha = 52.728$, $\alpha = 49.074$, $\alpha = 52.130$, and $\alpha = 45.703$, respectively. The regression coefficient (or slope of the line) were $\beta = 0.114$, $\beta = 0.022$, $\beta = 0.015$, $\beta = 0.061$, $\beta = 0.010$, and $\beta = 0.033$, respectively. Therefore, the regression equations were expressed as $Y = 50.742 + 0.114X$, $Y = 51.116 + 0.022X$, $Y = 52.728 + 0.015X$, $Y = 49.074 + 0.061X$, $Y = 52.130 + 0.10X$, and $Y = 45.703 + 0.033X$, respectively. The correlation coefficient r for the relation between frequency of page visits, which include page visits per login, resource views, user views, quiz views, and quiz review views, and discussion forum home page views, and students' perceived level of total engagement were: $r(36) = 0.069$ (p = 0.681), $r(36) = 0.0.062$ (p = 0.712), $r(36) = 0.014$ (p = 0.932), $r(36) = 0.140$ (p = 0.401), $r(36) = 0.063$ (p = 0.711), $r(36) = 0.294$ (p = 0.073), respectively. The relationship between frequency of page views per login and students' perceived level of total engagement was a low or weak

positive relationship. An increase in frequency of page views per login (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.005$; therefore, 0.5% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of page views per login (IV). The relationship between frequency of resource views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of resource views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.004$; therefore, 0.4% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of resource views (IV). The relationship between frequency of user views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.000$; therefore, 0.0% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of user views (IV). The relationship between frequency of quiz views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.020$; therefore, 2.0% of the variation in students' perceived level of total engagement

score (DV) can be accounted for by the variation in frequency of quiz views (IV). The relationship between frequency of quiz review views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of quiz review views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.004$; therefore, 0.4% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of quiz review views (IV). The relationship between frequency of discussion forum home page views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of discussion forum home page views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.087$; therefore, 8.7% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of discussion forum home page views (IV). The ratio of the variance that determines whether two variances—total engagement and frequency of page views per login—are equal was F-ratio = 0.172 (p = 0.681). The ratio of the variance that determines whether two variances are equal—total engagement and frequency of resource views—are equal was F-ratio = 0.139 (p = 0.712). The ratio of the variance that determines whether total engagement and frequency of user views are equal was F-ratio = 0.007 (p = 0.932). The ratio of the variance that determines whether two variances—total engagement and frequency of quiz views—are equal was F-ratio = 0.772 (p = 0.401). The ratio of the variance that determines whether two variances—total engagement and frequency of quiz review views—are equal was F-ratio = 0.139 (p = 0.711). Since the F-ratios

for the above findings were less than the F distribution critical value at $p = 0.10$, then the F-ratios were not significant. The ratio of the variance that determines whether two variances—total engagement and frequency of discussion forum home page views—are equal was F-ratio = 3.419 ($p = 0.073$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 24

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Page Visits (IV): Page Views/Login, Resource Views, User Views, Quiz Views, Quiz Review Views, Forum Views; and Students' Perceived Levels of Engagement (DV): Total Engagement and Skills Engagement, Emotional Engagement, Participation Engagement, and Performance Engagement Subcategories

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Total Engmt.	Page Visits	0.681	50.742	0.114	0.069	0.005	0.172
	Resource Views	0.712	51.116	0.022	0.062	0.004	0.139
	User Views	0.932	52.728	0.015	0.014	0.000	0.007
	Quiz Views	0.401	49.074	0.061	0.140	0.020	0.722
	Quiz Reviews	0.711	52.130	0.010	0.063	0.004	0.139
	Forum Views	0.073*	45.703	0.033	0.294	0.087	3.419***
Skills Engmt.	Page Visits	0.691	16.858	0.037	0.067	0.004	0.160
	Resource Views	0.919	17.749	-0.002	0.017	0.000	0.010
	User Views	0.700	17.242	0.023	0.065	0.004	0.151
	Quiz Views	0.775	17.130	0.007	0.048	0.002	0.083
	Quiz Reviews	0.318	16.747	0.011	0.200	0.040	1.453
	Forum Views	0.050**	14.911	0.011	0.320	0.102	4.111***
Emotional Engmt.	Page Visits	0.514	12.262	-0.024	0.109	0.012	0.094
	Resource Views	0.758	14.295	0.005	0.052	0.003	0.097
	User Views	0.562	14.305	0.029	0.097	0.009	0.343
	Quiz Views	0.814	14.422	0.005	0.039	0.002	0.056
	Quiz Reviews	0.764	15.021	-0.002	0.051	0.003	0.092
	Forum Views	0.250	13.379	0.005	0.191	0.037	1.364
Participation Engmt.	Page Visits	0.514	12.262	0.080	0.109	0.012	0.434
	Resource Views	0.345	11.744	0.025	0.158	0.025	0.916
	User Views	0.534	14.530	-0.048	0.104	0.011	0.395
	Quiz Views	0.236	11.397	0.038	0.197	0.039	1.450
	Quiz Reviews	0.852	13.878	-0.002	0.032	0.001	0.035
	Forum Views	0.136	11.116	0.014	0.247	0.061	2.330***
Performance Engmt.	Page Visits	0.463	6.416	0.021	0.123	0.015	0.550
	Resource Views	0.308	7.327	-0.006	0.170	0.029	1.068
	User Views	0.532	6.651	0.011	0.105	0.011	0.399
	Quiz Views	0.138	6.125	0.011	0.245	0.060	2.301***
	Quiz Reviews	0.158	6.484	0.004	0.237	0.056	2.080**
	Forum Views	0.214	6.298	0.002	0.206	0.043	1.603*

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for skills engagement the Y value was students' perceived level of skills engagement (DV), and the X values were frequencies of page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views. (IV). The y-intercepts were $\alpha = 16.858$, $\alpha = 17.749$, $\alpha = 17.242$, $\alpha = 17.130$, $\alpha = 16.747$, and $\alpha = 14.911$, respectively. The regression coefficient (or slope of the line) were $\beta = 0.037$, $\beta = -0.002$, $\beta = 0.023$, $\beta = 0.007$, $\beta = 0.011$, and $\beta = 0.011$, respectively. Therefore, the regression equations were expressed as $Y = 16.858 + 0.\ 0.037X$, $Y = 17.749 – 0.002X$, $Y = 17.242 + 0.023X$, $Y = 17.130 + 0.007X$, $Y = 16.747 + 0.011X$, and $Y = 14.911 + 0.011X$, respectively. The correlation coefficient *r* for the relation between frequency of page visits, which include page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views, and students' perceived level of skills engagement, were $r(36) = 0.067$ ($p = 0.691$), $r(36) = 0.017$ ($p = 0.919$), $r(36) = 0.065$ ($p = 0.700$), $r(36) = 0.048$ ($p = 0.775$), $r(36) = 0.200$ ($p = 0.318$), $r(36) = 0.320$ ($p = 0.050$), respectively. The relationship between frequency of page visits per log in and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of page views per login (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.004$; therefore, 0.4% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of page views per login (IV). There was no relationship between frequency of resource views and students' perceived level of skills engagement. An increase in frequency of resource views (IV) had no association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the

other variable was $R^2 = 0.000$; therefore, 0.0% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of resource views (IV). The relationship between frequency of user views and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.004$; therefore, 0.4% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of user views (IV). The relationship between frequency of quiz views and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.002$; therefore, 0.2% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of quiz views (IV). The relationship between frequency of quiz review views and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of quiz review views (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.040$; therefore, 4.0% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of quiz review views (IV). The relationship between frequency of discussion forum home page views and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of discussion

forum home page views (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.102$; therefore, 10.2% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—skills engagement and frequency of page visits per login—are equal was F-ratio = 0.160 ($p = 0.691$). The ratio of the variance that determines whether two variances—skills engagement and frequency of page visits per login —are equal was F-ratio = 0.160 ($p = 0.691$). The ratio of the variance that determines whether two variances—skills engagement and frequency of resource views—are equal was F-ratio = 0.010 ($p = 0.919$). The ratio of the variance that determines whether two variances—skills engagement and frequency of user views—are equal was F-ratio = 0.151 ($p = 0.700$). The ratio of the variance that determines whether two variances—skills engagement and frequency of quiz views—are equal was F-ratio = 0.083 ($p = 0.775$). The ratio of the variance that determines whether two variances—skills engagement and frequency of quiz review views—are equal was F-ratio = 1.453 ($p = 0.318$). Since the F-ratios for the above findings were less than the F distribution critical value at $p = 0.10$, then the F-ratios were not significant. The ratio of the variance that determines whether two variances—skills engagement and frequency of discussion forum home page views—are equal was F-ratio = 4.111 ($p = 0.050$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for emotional engagement the Y value was students' perceived level of emotional engagement (DV), and the X values were frequencies of page visits

per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views. (IV). The y-intercepts were $\alpha = 12.262$, $\alpha = 14.295$, $\alpha = 14.305$, $\alpha = 14.422$, $\alpha = 15.021$, and $\alpha = 13.379$, respectively. The regression coefficient (or slope of the line) were $\beta = -0.024$, $\beta = 0.005$, $\beta = 0.029$, $\beta = 0.005$, $\beta = -0.002$, and $\beta = 0.005$, respectively. Therefore, the regression equations were expressed as $Y = 12.262 – 0.024X$, $Y = 14.295 + 0.005X$, $Y = 14.305 + 0.029X$, $Y = 14.422 + 0.005X$, $Y = 15.021 – 0.002X$, and $Y = 13.379 + 0.005X$, respectively. The correlation coefficient *r* for the relation between frequency of page visits, which include page visits per login, resource views, user views, quiz views, and quiz review views, and discussion forum home page views, and students' perceived level of emotional engagement were $r(36) = 0.109$ ($p = 0.514$), $r(36) = 0.052$ ($p = 0.758$), $r(36) = 0.097$ ($p = 0.562$), $r(36) = 0.039$ ($p = 0.814$), $r(36) = 0.051$ ($p = 0.764$), $r(36) = 0.191$ ($p = 0.250$), respectively. The relationship between frequency of page visits per login and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of page views per login (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.012$; therefore, 1.2% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of page visits per login (IV). The relationship between frequency of resource views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of resource views (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.003$; therefore, 0.3% of the variation in students' perceived level of emotional engagement (DV) can

be accounted for by the variation in frequency of resource views (IV). The relationship between frequency of user views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.009$; therefore, 0.9% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of user views (IV). The relationship between frequency of quiz views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.002$; therefore, 0.2% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of quiz views (IV). The relationship between frequency of quiz review views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of quiz review views (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.003$; therefore, 0.3% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of quiz review views (IV). The relationship between frequency of discussion forum home page views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of discussion forum home page views (IV) had a low or weak association with an increase in

students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.037$; therefore, 3.7% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of discussion forum home page views (IV). The ratio of the variance that determines whether two variances—emotional engagement and frequency of page visits per login—are equal was F-ratio = 0.094 ($p = 0.514$). The ratio of the variance that determines whether two variances—emotional engagement and frequency of resource views—are equal was F-ratio = 0.097 ($p = 0.758$). The ratio of the variance that determines whether two variances—emotional engagement and frequency of user views—are equal was F-ratio = 0.343 ($p = 0.562$). The ratio of the variance that determines whether two variances—emotional engagement and frequency of quiz views—are equal was F-ratio = 0.056 ($p = 0.814$). The ratio of the variance that determines whether two variances—emotional engagement and frequency of quiz review views—are equal was F-ratio = 0.092 ($p = 0.764$). The ratio of the variance that determines whether two variances—emotional engagement and frequency of discussion forum home page views—are equal was F-ratio = 1.364 ($p = 0.250$). Since the F-ratios for the above findings were less than the F distribution critical value at $p = 0.10$, then the F-ratios were not significant.

Plotting the regression equation for participation engagement the Y value was students' perceived level of participation engagement (DV), and the X values were frequencies of page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views. (IV). The y-intercepts were $\alpha = 12.262$, $\alpha = 11.744$, $\alpha = 14.530$, $\alpha = 11.397$, $\alpha = 13.878$, and $\alpha = 11.116$, respectively. The regression coefficient (or slope of the line) were $\beta = 0.080$, $\beta = 0.025$, $\beta = -0.048$, $\beta = 0.038$, $\beta = -0.002$, and $\beta = 0.014$, respectively. Therefore, the

regression equations were expressed as Y = 12.262 + 0.080X, Y = 11.744 + 0.025X, Y = 14.530 – 0.048X, Y = 11.397 + 0.038X, Y = 13.878 – 0.002X, and Y = 11.116 + 0.014X, respectively. The correlation coefficient r for the relation between frequency of page visits, which include page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views, and students' perceived level of engagement in the participation subcategory were: $r(36) = 0.109$ ($p = 0.514$), $r(36) = 0.158$ ($p = 0.345$), $r(36) = 0.104$ ($p = 0.534$), $r(36) = 0.197$ ($p = 0.236$), $r(36) = 0.032$ ($p = 0.852$), $r(36) = 0.247$ ($p = 0.136$), respectively. The relationship between frequency of page visits per login and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of page visits per login (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.012$; therefore, 1.2% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of page visits per logins (IV). The relationship between frequency of resource views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of resource views (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.025$; therefore, 2.5% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of resource views (IV). The relationship between frequency of user views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in

students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.011$; therefore, 1.1% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of user views (IV). The relationship between frequency of quiz views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.039$; therefore, 3.9% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of quiz views (IV). The relationship between frequency of quiz review views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of quiz review views (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.001$; therefore, 0.1% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of quiz review views (IV). The relationship between frequency of discussion forum home page views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of discussion forum home page views (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.061$; therefore, 6.1% of the variation in students' perceived level of participation engagement (DV) can be accounted for by

the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—participation engagement and frequency of page visits per login—are equal was F-ratio = 0.434 (p = 0.514). The ratio of the variance that determines whether two variances—participation engagement and frequency of resource views—are equal was F-ratio = 0.916 (p = 0.345). The ratio of the variance that determines whether two variances—participation engagement and frequency of user views—are equal was F-ratio = 0.395 (p = 0.534). The ratio of the variance that determines whether two variances—participation engagement and frequency of quiz views—are equal was F-ratio = 1.450 (p = 0.236). The ratio of the variance that determines whether two variances—participation engagement and frequency of quiz review views—are equal was F-ratio = 0.035 (p = 0.852). Since the F-ratios of the above findings were less than the F distribution critical value at p = 0.10, then the F-ratios were not significant. The ratio of the variance that determines whether two variances—participation engagement and frequency of discussion forum home page views—are equal was F-ratio = 2.333 (p = 0.136). Since the F-ratio was greater than the F distribution critical value at p = 0.10, then F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for performance engagement the Y value was students' perceived level of performance engagement (DV), and the X values were frequencies of page visits per login, resource views, user views, quiz views, quiz review views, and discussion forum home page views. (IV). The y-intercepts were $\alpha = 6.416$, $\alpha = 7.327$, $\alpha = 6.651$, $\alpha = 6.125$, $\alpha = 6.484$, and $\alpha = 6.298$, respectively. The regression coefficient (or slope of the line) were $\beta = 0.021$, $\beta = -0.006$, $\beta = 0.011$, $\beta = 0.011$, $\beta = 0.004$, and $\beta = 0.002$, respectively. Therefore, the regression equations were expressed as $Y = 6.416 + 0.021X$, $Y = 7.327 – 0.006X$, $Y = 6.651 + 0.011X$, $Y = 6.125 + 0.011X$, $Y = 6.484 + 0.004X$, and $Y = 6.298 + 0.002X$, respectively. The

correlation coefficient r for the relation between frequency of page visits, which include page views per login, resource views, user views, quiz views, and quiz review views, and students' perceived level of engagement in the performance subcategory were: $r(36) = 0.123$ ($p = 0.463$), $r(36) = 0.170$ ($p = 0.308$), $r(36) = 0.105$ ($p = 0.532$), $r(36) = 0.245$ ($p = 0.138$), $r(36) = 0.237$ ($p = 0.158$), $r(36) = 0.206$ ($p = 0.214$), respectively. The relationship between frequency of page visits per login and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of page visits per login (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.015$; therefore, 1.5% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of page visits per logins (IV). The relationship between frequency of resource views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of resource views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.029$; therefore, 2.9% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of resource views (IV). The relationship between frequency of user views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.011$; therefore, 1.1% of the variation in students' perceived level of

performance engagement (DV) can be accounted for by the variation in frequency of user views (IV). The relationship between frequency of quiz views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.060$; therefore, 6.0% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of quiz views (IV). The relationship between frequency of quiz review views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of quiz review views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.056$; therefore, 5.6% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of quiz review views (IV). The relationship between frequency of discussion forum home page views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.043$; therefore, 4.3% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of discussion forum home page views (IV). The ratio of the variance that determines whether two variances—performance engagement and frequency of page visits per login—are equal was F-ratio = 0.550 ($p = 0.463$).

The ratio of the variance that determines whether two variances—performance engagement and frequency of resource views—are equal was F-ratio = 1.068 ($p = 0.308$). The ratio of the variance that determines whether two variances—performance engagement and frequency of user views—are equal was F-ratio = 0.399 ($p = 0.532$). Since the F-ratios of the above findings were less than the F distribution critical value at $p = 0.10$, then the F-ratios were not significant. The ratio of the variance that determines whether two variances—performance engagement and frequency of quiz views—are equal was F-ratio = 2.301 ($p = 0.138$). The ratio of the variance that determines whether two variances—performance engagement and frequency of quiz review views—are equal was F-ratio = 2.080 ($p = 0.158$). The ratio of the variance that determines whether two variances—performance engagement and frequency of discussion forum home views—are equal was F-ratio = 1.603 ($p = 0.214$). Since the F-ratio for the above findings were greater than the F distribution critical value at $p = 0.10$, then the F-ratios were significant and indicated an overall goodness of fit of the regression equation.

Research sub-question #1c. What is the relationship between students' perceived level of engagement and frequency of discussion forum views?

Findings. Table 25 summarizes the findings when performing correlation and regression analysis for students' perceived level of engagement (DV) and frequency of discussion forum views (IV). For total engagement, the regression equation, $Y = \alpha + \beta X$, models the relationship between two variables by fitting observed data to a straight line. The Y value was students' perceived level of total engagement (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was $\alpha = 47.398$. The regression coefficient (or slope of the line) was $\beta = 0.028$. Therefore, the regression equation was expressed as $Y = 47.398 + 0.028X$. The correlation coefficient r for the relation between frequency of discussion forum views and

students' perceived level of total engagement was $r(36) = 0.240$ ($p = 0.147$). The relationship between frequency of discussion forum views and students' perceived level of total engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of total engagement. The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.058$; therefore, 5.8% of the variation in students' perceived level of total engagement score (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—total engagement and frequency of discussion forum views—are equal was F-ratio = 2.200 ($p = 0.147$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 25

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Discussion Forum Views (IV) and Students' Perceived Levels of Engagement (DV): Total Engagement and Skills Engagement, Emotional Engagement, Participation Engagement, and Performance Engagement Subcategories

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Total Engmt.	Forum Views	0.147	47.398	0.028	0.240	0.058	2.200***
Skills Engmt.		0.102	15.470	0.011	0.269	0.072	2.811***
Emotional Engmt.		0.319	13.627	0.006	0.166	0.028	1.021
Participation Engmt.		0.281	11.967	0.009	0.180	0.032	1.200
Performance Engmt.		0.218	6.334	0.002	0.204	0.042	1.569*

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for skills engagement the Y value was students' perceived level of skills engagement (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was $\alpha = 15.470$. The regression coefficient (or slope of the line) was $\beta = 0.011$. Therefore, the regression equation was expressed as $Y = 15.470 + 0.011X$. The correlation coefficient *r* for the relation between frequency of discussion forum views and students' perceived level of skills engagement was $r(36) = 0.269$ ($p = 0.102$). The relationship between frequency of discussion forum views and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.072$; therefore, 7.2% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—skills engagement and frequency of discussion forum views—are equal was F-ratio =

2.811 ($p = 0.102$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for emotional engagement the Y value was students' perceived level of emotional engagement (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was $\alpha = 13.627$. The regression coefficient (or slope of the line) was $\beta = 0.006$. Therefore, the regression equation was expressed as $Y = 13.627 + 0.006X$. The correlation coefficient r for the relation between frequency of discussion forum views and students' perceived level of emotional engagement was $r(36) = 0.166$ ($p = 0.319$). The relationship between frequency of discussion forum views and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of emotional engagement in total engagement subcategory (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.028$; therefore, 2.8% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—emotional engagement and frequency of discussion forum views—are equal was F-ratio = 1.021 ($p = 0.319$). Since the F-ratio was less than the F distribution critical value at $p = 0.10$, then the F-ratio was not significant.

Plotting the regression equation for participation engagement the Y value was students' perceived level of participation engagement (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was $\alpha = 11.967$. The regression coefficient (or slope of the

line) was β = 0.009. Therefore, the regression equation was expressed as Y = 11.967 + 0.009X. The correlation coefficient *r* for the relation between frequency of discussion forum views and students' perceived level of participation engagement was $r(36) = 0.180$ ($p = 0.281$). The relationship between frequency of discussion forum views and students' perceived level of participation engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.032$; therefore, 3.2% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—participation engagement and frequency of discussion forum views—are equal was F-ratio = 1.200 ($p = 0.281$). Since the F-ratio was less than the F distribution critical value at $p = 0.10$, then the F-ratio was not significant.

Plotting the regression equation for performance engagement the Y value was students' perceived level of performance engagement (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was α = 6.334. The regression coefficient (or slope of the line) was β = 0.002. Therefore, the regression equation was expressed as Y = 6.334 + 0.002X. The correlation coefficient *r* for the relation between frequency of discussion forum views and students' perceived level of performance engagement was $r(36) = 0.204$ ($p = 0.218$). The relationship between frequency of discussion forum views and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of discussion forum views (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the

proportion of variance of one variable predicted from the other variable was $R^2 = 0.042$; therefore, 4.2% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—performance engagement and frequency of discussion forum views—are equal was F-ratio = 1.569 ($p = 0.218$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research sub-question #1d. What is the relationship between students' perceived level of engagement and frequency of original discussion forum posts?

Findings. Table 26 summarizes the findings when performing correlation and regression analysis for students' perceived level of engagement (DV) and frequency of discussion forum posts (IV). The regression equation, $Y = \alpha + \beta X$, models the relationship between two variables by fitting observed data to a straight line. The Y value was students' perceived level of total engagement (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 44.288$. The regression coefficient (or slope of the line) was $\beta = 0.658$. Therefore, the regression equation was expressed as $Y = 44.288 + 0.658X$. The correlation coefficient r for the relation between frequency of discussion forum posts and students' perceived level of total engagement was $r(36) = 0.367$ ($p = 0.023$). The relationship between frequency of discussion forum posts and students' perceived level of total engagement was a modest or moderate positive relationship. An increase in frequency of discussion forum posts (IV) had a modest or moderate association with an increase in students' perceived level of total engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.135$; therefore, 13.5% of the variation in

students' perceived level of total engagement (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—performance engagement and frequency of discussion forum posts—are equal was F-ratio = 5.621 ($p = 0.023$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 26

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Discussion Forum Posts (IV) and Students' Perceived Levels of Engagement (DV): Total OSES, Skills, Emotional, Participation, and Performance

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Total Engmt.	Forum Posts	0.023**	44.288	0.658	0.367	0.135	5.621***
Skills Engmt.		0.063*	15.151	0.185	0.304	0.092	3.668***
Emotional Engmt.		0.116	12.970	0.134	0.260	0.067	2.600***
Participation Engmt.		0.026**	10.037	0.287	0.360	0.130	5.368***
Performance Engmt.		0.082*	6.129	0.052	0.286	0.082	3.196***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for skills engagement the Y value was students' perceived level of skills engagement (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 15.151$. The regression coefficient (or slope of the line) was $\beta = 0.185$. Therefore, the regression equation was expressed as $Y = 15.151 + 0.185X$. The correlation coefficient *r* for the relation between frequency of discussion forum posts and students' perceived level of skills engagement was $r(36) = 0.304$ ($p = 0.063$). The relationship between frequency of discussion forum posts and students' perceived level of skills engagement was a low or weak positive relationship. An increase in frequency of discussion forum posts (IV) had a low or weak association with an increase in students' perceived level of skills engagement

(DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.092$; therefore, 9.2% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—skills engagement and frequency of discussion forum posts—are equal was F-ratio = 3.668 (p = 0.063). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for emotional engagement the Y value was students' perceived level of emotional engagement (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 12.971$. The regression coefficient (or slope of the line) was $\beta = 0.134$. Therefore, the regression equation was expressed as $Y = 12.971 + 0.134X$. The correlation coefficient r for the relation between frequency of discussion forum posts and students' perceived level of emotional engagement was $r(36) = 0.260$ ($p = 0.116$). The relationship between frequency of discussion forum posts and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of discussion forum posts (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.067$; therefore, 6.7% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—emotional engagement and frequency of discussion forum posts—are equal was F-ratio = 2.600 ($p = 0.116$). Since the F-ratio was greater

than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for participation engagement the Y value was students' perceived level of participation engagement (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 10.037$. The regression coefficient (or slope of the line) was $\beta = 0.287$. Therefore, the regression equation was expressed as $Y = 10.037 + 0.287X$. The correlation coefficient r for the relation between frequency of discussion forum posts and students' perceived level of participation engagement was $r(36) = 0.360$ ($p = 0.026$). The relationship between frequency of discussion forum posts and students' perceived level of participation engagement was a modest or moderate positive relationship. An increase in frequency of discussion forum posts (IV) had a modest or moderate association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.130$; therefore, 13.0% of the variation in students' perceived level of participation engagement (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—participation engagement and frequency of discussion forum posts—are equal was F-ratio = 5.368 ($p = 0.026$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for performance engagement the Y value was students' perceived level of performance engagement (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 6.129$. The regression coefficient (or slope of the line) was $\beta = 0.052$. Therefore, the regression equation was expressed as $Y = 6.129 + 0.052X$. The

correlation coefficient *r* for the relation between frequency of discussion forum posts and students' perceived level of performance engagement was $r(36) = 0.286$ ($p = 0.082$). The relationship between frequency of discussion forum posts and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of discussion forum posts (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.082$; therefore, 8.2% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—performance engagement and frequency of discussion forum posts—are equal was F-ratio = 3.196 ($p = 0.082$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research Sub-question #1e. What is the relationship between students' perceived level of engagement and frequency of discussion forum replies?

Findings. Table 27 summarizes the findings for correlation and regression analysis for students' perceived level of engagement (DV) and frequency of discussion forum replies (IV). Plotting the regression equation for total engagement the Y value was students' perceived level of total engagement (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 43.335$. The regression coefficient (or slope of the line) was $\beta = 0.658$. Therefore, the regression equation was expressed as $Y = 43.335 + 0.658X$. The correlation coefficient *r* for the relation between frequency of discussion forum replies and students' perceived level of total engagement was $r(36) = 0.425$ ($p = 0.008$). The relationship between

frequency of discussion forum replies and students' perceived level of total engagement was a modest or moderate positive relationship. An increase in frequency of discussion forum replies (IV) had a modest or moderate association with an increase in students' perceived level of total engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.181$; therefore, 18.1% of the variation in students' perceived level of total engagement (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—total engagement and frequency of forum replies—are equal was F-ratio = 7.930 ($p = 0.008$). Since the F-ratio was greater than the F distribution critical value at $p = 0.01$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 27

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Discussion Forum Replies (IV) and Students' Perceived Levels of Engagement (DV): Total OSES, Skills, Emotional, Participation, and Performance

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Total Engmt.	Forum Replies	0.008***	42.335	0.658	0.425	0.181	7.930***
Skills Engmt.		0.025**	14.495	0.151	0.364	0.133	5.512***
Emotional Engmt.		0.052*	12.445	0.113	0.318	0.101	4.038***
Participation Engmt.		0.008***	9.115	0.231	0.423	0.179	7.833***
Performance Engmt.		0.205	6.280	0.026	0.210	0.044	1.666*

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for skills engagement the Y value was students' perceived level of skills engagement (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 14.495$. The regression coefficient (or slope of the line) was $\beta = 0.151$. Therefore, the regression equation was expressed as $Y = 14.495 + 0.151X$. The correlation coefficient *r* for the relation between frequency of discussion forum replies and

students' perceived level of skills engagement was $r(36) = 0.364$ ($p = 0.025$). The relationship between frequency of discussion forum replies and students' perceived level of skills engagement was a modest or moderate positive relationship. An increase in frequency of discussion forum replies (IV) had a modest or moderate association with an increase in students' perceived level of skills engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.133$; therefore, 13.3% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—skills engagement and frequency of discussion forum replies—are equal was F-ratio = 5.512 ($p = 0.025$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for emotional engagement the Y value was students' perceived level of emotional engagement (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 12.445$. The regression coefficient (or slope of the line) was $\beta = 0.113$. Therefore, the regression equation was expressed as $Y = 12.445 + 0.113X$. The correlation coefficient r for the relation between frequency of discussion forum replies and students' perceived level of emotional engagement was $r(36) = 0.318$ ($p = 0.052$). The relationship between frequency of discussion forum replies and students' perceived level of emotional engagement was a low or weak positive relationship. An increase in frequency of discussion forum replies (IV) had a low or weak association with an increase in students' perceived level of emotional engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.101$;

therefore, 10.1% of the variation in students' perceived level of emotional engagement (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—emotional engagement and frequency of discussion forum replies—are equal was F-ratio = 4.038 ($p = 0.052$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for participation engagement the Y value was students' perceived level of participation engagement (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 9.115$. The regression coefficient (or slope of the line) was $\beta = 0.231$. Therefore, the regression equation was expressed as $Y = 9.115 + 0.231X$. The correlation coefficient r for the relation between frequency of discussion forum replies and students' perceived level of participation engagement was $r(36) = 0.423$ ($p = 0.008$). The relationship between frequency of discussion forum replies and students' perceived level of participation engagement was a modest or moderate positive relationship. An increase in frequency of discussion forum replies (IV) had a modest or moderate association with an increase in students' perceived level of participation engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.179$; therefore, 17.9% of the variation in students' perceived level of skills engagement (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—participation engagement and frequency of discussion forum replies—are equal was F-ratio = 7.833 ($p = 0.008$). Since the F-ratio was greater than the F distribution critical value at $p = 0.01$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for performance engagement the Y value was students' perceived level of performance engagement (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 6.280$. The regression coefficient (or slope of the line) was $\beta = 0.026$. Therefore, the regression equation was expressed as $Y = 6.280 + 0.026X$. The correlation coefficient r for the relation between frequency of discussion forum replies and students' perceived level of performance engagement was $r(36) = 0.210$ ($p = 0.205$). The relationship between frequency of discussion forum replies and students' perceived level of performance engagement was a low or weak positive relationship. An increase in frequency of discussion forum replies (IV) had a low or weak association with an increase in students' perceived level of performance engagement (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.044$; therefore, 4.4% of the variation in students' perceived level of performance engagement (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—performance engagement and frequency of discussion forum replies—are equal was F-ratio = 1.666 ($p = 0.205$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research Question #2

What is the relationship between students' perceived level of engagement and student success?

Findings. Table 28 summarizes the findings when performing correlation and regression analysis for student success (DV) and students' perceived level of engagement (IV). Plotting the regression equation for students' perceived level of total engagement the Y value was student

success (DV), and the X value was students' perceived level of total engagement (IV). The y-intercept was $\alpha = 60.380$. The regression coefficient (or slope of the line) was $\beta = 0.313$. Therefore, the regression equation was expressed as $Y = 60.380 + 0.313X$. The correlation coefficient *r* for the relation between students' perceived level of total engagement and student success was $r(36) = 0.377$ ($p = 0.019$). The relationship between students' perceived level of total engagement and student success was a modest or moderate positive relationship. An increase in students' perceived level of engagement (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.142$; therefore, 14.2% of the variation in student success (DV) can be accounted for by the variation in students' perceived level of total engagement (IV). The ratio of the variance that determines whether two variances—student success and students' perceived level of total engagement—are equal was F-ratio = 5.982 ($p = 0.019$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 28

Regression Analysis to Determine Whether Relationships Exist Between Student Success (DV) and Students' Perceived Levels of Engagement (IV): Total OSES, Skills, Emotional, Participation, and Performance

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Total Engmt.	0.019**	60.380	0.313	0.377	0.142	5.982***
	Skills Engmt.	0.036**	62.298	0.835	0.341	0.116	4.728***
	Emotional Engmt.	0.161	67.145	0.667	0.232	0.054	2.050**
	Participation Engmt.	0.028**	67.810	0.663	0.356	0.126	5.211***
	Performance Engmt.	0.027**	57.032	2.926	0.359	0.129	5.342***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for students' perceived level of skills engagement the Y value was student success (DV), and the X value was students' perceived level of skills engagement (IV). The y-intercept was $\alpha = 62.298$. The regression coefficient (or slope of the line) was $\beta = 0.835$. Therefore, the regression equation was expressed as $Y = 62.298 + 0.835X$. The correlation coefficient *r* for the relation between students' perceived level of skills engagement and student success was $r(36) = 0.341$ ($p = 0.036$). The relationship between students' perceived level of skills engagement and student success was a low or weak positive relationship. An increase in students' perceived level of skills engagement (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.116$; therefore, 11.6% of the variation in student success (DV) can be accounted for by the variation in students' perceived level of skills engagement (IV). The ratio of the variance that determines whether two variances—student success and students' perceived level of skills engagement—are equal was F-ratio = 4.728 ($p = 0.036$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for students' perceived level of emotional engagement the Y value was student success (DV), and the X value was students' perceived level of emotional engagement (IV). The y-intercept was $\alpha = 67.145$. The regression coefficient (or slope of the line) was $\beta = 0.667$. Therefore, the regression equation was expressed as $Y = 67.145 + 0.667X$. The correlation coefficient *r* for the relation between students' perceived level of emotional engagement and student success was $r(36) = 0.232$ ($p = 0.161$). The relationship between students' perceived level of emotional engagement and student success was a low or

weak positive relationship. An increase in students' perceived level of emotional engagement (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.054$; therefore, 5.4% of the variation in student success (DV) can be accounted for by the variation in students' perceived level of emotional engagement (IV). The ratio of the variance that determines whether two variances—student success and students' perceived level of emotional engagement—are equal was F-ratio = 2.050 ($p = 0.161$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for students' perceived level of participation engagement the Y value was student success (DV), and the X value was students' perceived level of participation engagement (IV). The y-intercept was $\alpha = 67.810$. The regression coefficient (or slope of the line) was $\beta = 0.663$. Therefore, the regression equation was expressed as $Y = 67.810 + 0.663X$. The correlation coefficient r for the relation between students' perceived level of participation engagement and student success was $r(36) = 0.356$ ($p = 0.028$). The relationship between students' perceived level of participation engagement and student success was a low or weak positive relationship. An increase in students' perceived level of participation engagement (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.126$; therefore, 12.6% of the variation in student success (DV) can be accounted for by the variation in students' perceived level of participation engagement (IV). The ratio of the variance that determines whether two variances—student success and students' perceived level of participation engagement—are equal was F-ratio = 5.211 ($p = 0.028$). Since the F-ratio was

greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for students' perceived level of performance engagement the Y value was student success (DV), and the X value was students' perceived level of performance engagement (IV). The y-intercept was $\alpha = 57.032$. The regression coefficient (or slope of the line) was $\beta = 2.926$. Therefore, the regression equation was expressed as $Y = 57.032 + 2.926X$. The correlation coefficient r for the relation between students' perceived level of performance engagement and student success was $r(36) = 0.359$ ($p = 0.027$). The relationship between students' perceived level of performance engagement and student success was a low or weak positive relationship. An increase in students' perceived level of performance engagement (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.129$; therefore, 12.9% of the variation in student success (DV) can be accounted for by the variation in students' perceived level of performance engagement (IV). The ratio of the variance that determines whether two variances—student success and students' perceived level of performance engagement—are equal was F-ratio = 5.342 ($p = 0.027$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research Question #3

What is the relationship between students' actual level of engagement as measured by an LMS and students' success in an online course?

Research sub-question #3a. What is the relationship between students' frequency of student logins on an LMS and students' success?

Findings. Table 29 summarizes the findings when performing correlation and regression analysis for student success (DV) and frequency of logins (IV). Plotting the regression equation for frequency of logins the Y value was student success (DV), and the X value was frequency of logins (IV). The y-intercept was $\alpha = 70.735$. The regression coefficient (or slope of the line) was $\beta = 0.078$. Therefore, the regression equation was expressed as $Y = 70.735 + 0.078X$. The correlation coefficient *r* for the relation between frequency of logins and student success was $r(36) = 0.256$ ($p = 0.120$). The relationship between frequency of logins and student success was a low or weak positive relationship. An increase in frequency of logins (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.066$; therefore, 6.6% of the variation in student success (DV) can be accounted for by the variation frequency of logins (IV). The ratio of the variance that determines whether two variances—student success and frequency of logins—are equal was F-ratio = 2.531 ($p = 0.120$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 29

Regression Analysis to Determine Whether a Relationship Exists Between Frequency of Logins (IV) and Student Success (DV)

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Logins	0.120	70.735	0.078	0.256	0.066	2.531***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Research sub-question #3b. What is the relationship between students' frequency of page visits on an LMS and students' success?

Findings. Table 30 summarizes the findings when performing correlation and regression analysis for student success (DV) and frequency of page visits (IV). Plotting the regression equation for frequency of page visits per login the Y value was student success (DV), and the X value was frequency of page visits per logins (IV). The y-intercept was $\alpha = 74.076$. The regression coefficient (or slope of the line) was $\beta = 0.150$. Therefore, the regression equation was expressed as $Y = 74.076 + 0.150X$. The correlation coefficient r for the relation between frequency of page views per login and student success was $r(36) = 0.109$ ($p = 0.514$). The relationship between frequency of page views per login and student success was a low or weak positive relationship. An increase in frequency of page views per login (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.012$; therefore, 1.2% of the variation in student success (DV) can be accounted for by the variation frequency of page views per login (IV). The ratio of the variance that determines whether two variances—student success and frequency of page visits per login—are equal was F-ratio = 0.434 ($p = 0.514$). Since the F-ratio was less than the F distribution critical value at $p = 0.10$, then the F-ratio was not significant.

Table 30

Regression Analysis to Determine Whether Relationships Exist Between Student Success (DV) and Frequency of Page Visits (IV): Page Views/Login, Resource Views, User Views, Quiz Views, Quiz Review Views, Form Home View

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Page Visits	0.514	74.076	0.150	0.109	0.012	0.434
	Resource Views	0.568	74.625	0.028	0.096	0.009	0.333
	User Views	0.517	75.587	0.093	0.108	0.012	0.428
	Quiz Views	0.065*	70.037	0.110	0.302	0.091	3.625***
	Quiz Reviews	0.024**	73.058	0.050	0.371	0.138	5.592***
	Forum Views	0.018**	69.144	0.032	0.383	0.147	6.202***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Plotting the regression equation for frequency of resource views the Y value was student success (DV), and the X value was frequency of resource views (IV). The y-intercept was $\alpha = 74.625$. The regression coefficient (or slope of the line) was $\beta = 0.028$. Therefore, the regression equation was expressed as $Y = 74.625 + 0.028X$. The correlation coefficient *r* for the relation between frequency of resource views and student success was $r(36) = 0.096$ ($p = 0.568$). The relationship between frequency of resource views and student success was a low or weak positive relationship. An increase in frequency of resource views (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.009$; therefore, 0.9% of the variation in student success (DV) can be accounted for by the variation frequency of resource views (IV). The ratio of the variance that determines whether two variances—student success and frequency of resource views—are equal was F-ratio = 0.333 ($p = 0.568$). Since the F-ratio was less than the F distribution critical value at $p = 0.10$, then the F-ratio was not significant.

Plotting the regression equation for frequency of user views the Y value was student success (DV), and the X value was frequency of user views (IV). The y-intercept was $\alpha = 75.587$. The regression coefficient (or slope of the line) was $\beta = 0.093$. Therefore, the regression equation was expressed as $Y = 75.587 + 0.093X$. The correlation coefficient r for the relation between frequency of user views and student success was $r(36) = 0.108$ ($p = 0.517$). The relationship between frequency of user views and student success was a low or weak positive relationship. An increase in frequency of user views (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.012$; therefore, 1.2% of the variation in student success (DV) can be accounted for by the variation frequency of user views (IV). The ratio of the variance that determines whether two variances—student success and frequency of user views—are equal was F-ratio = 0.428 ($p = 0.517$). Since the F-ratio was less than the F distribution critical value at $p = 0.10$, then the F-ratio was not significant.

Plotting the regression equation for frequency of quiz views the Y value was student success (DV), and the X value was frequency of quiz views (IV). The y-intercept was $\alpha = 70.037$. The regression coefficient (or slope of the line) was $\beta = 0.110$. Therefore, the regression equation was expressed as $Y = 70.037 + 0.110X$. The correlation coefficient r for the relation between frequency of quiz views and student success was $r(36) = 0.302$ ($p = 0.065$). The relationship between frequency of quiz views and student success was a low or weak positive relationship. An increase in frequency of quiz views (IV) had a low or weak association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.091$; therefore, 9.1% of the variation in student success (DV) can be accounted for by the variation frequency of quiz views

(IV). The ratio of the variance that determines whether two variances—student success and frequency of quiz views—are equal was F-ratio = 3.625 ($p = 0.065$). Since the F-ratio was greater than the F distribution critical value at $p = 0.10$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for frequency of quiz review views the Y value was student success (DV), and the X value was frequency of quiz review views (IV). The y-intercept was $\alpha = 73.058$. The regression coefficient (or slope of the line) was $\beta = 0.050$. Therefore, the regression equation was expressed as $Y = 73.058 + 0.050X$. The correlation coefficient r for the relation between frequency of quiz review views and student success was $r(36) = 0.371$ ($p = 0.024$). The relationship between frequency of quiz review views and student success was a modest or moderate positive relationship. An increase in frequency of quiz review views (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.138$; therefore, 13.8% of the variation in student success (DV) can be accounted for by the variation in frequency of quiz review views (IV). The ratio of the variance that determines whether two variances—student success and frequency of quiz review views—are equal was F-ratio = 5.592 ($p = 0.024$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Plotting the regression equation for frequency of discussion forum home page views (discussion forum *home page* is defined as the discussion forum link found on the LMS's home page) the Y value was student success (DV), and the X value was frequency of discussion forum home page views (IV). The y-intercept was $\alpha = 69.144$. The regression coefficient (or slope of

the line) was β = 0.032. Therefore, the regression equation was expressed as Y = 69.144 + 0.032X. The correlation coefficient *r* for the relation between frequency of discussion forum home page views and student success was $r(36) = 0.383$ ($p = 0.018$). The relationship between frequency of discussion forum home page views and student success was a modest or moderate positive relationship. An increase in frequency of discussion forum home page views (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.147$; therefore, 14.7% of the variation in student success (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—student success and frequency of discussion forum home page views—are equal was F-ratio = 6.202 ($p = 0.018$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Research sub-question #3c. What is the relationship between students' frequency of discussion forum views and students' success?

Findings. Table 31 summarizes the findings when performing correlation and regression analysis for student success (DV) and frequency of discussion forum views (discussion forum views is defined as the original posting for that discussion thread). Plotting the regression equation for frequency of discussion forum views the Y value was student success (DV), and the X value was frequency of discussion forum views (IV). The y-intercept was α = 69.427. The regression coefficient (or slope of the line) was β = 0.038. Therefore, the regression equation was expressed as Y = 69.427 + 0.038X. The correlation coefficient *r* for the relation between frequency of discussion forum views and student success was $r(36) = 0.393$ ($p = 0.015$). The

relationship between frequency of discussion forum views and student success was a modest or moderate positive relationship. An increase in frequency of discussion forum views (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.154$; therefore, 15.4% of the variation in student success (DV) can be accounted for by the variation in frequency of discussion forum views (IV). The ratio of the variance that determines whether two variances—student success and frequency of discussion forum views—are equal was F-ratio = 6.578 ($p = 0.015$). Since the F-ratio was greater than the F distribution critical value at $p = 0.05$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 31

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Discussion Forum Views (IV) and Student Success (DV)

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Forum Views	0.015**	69.427	0.038	0.393	0.154	6.578***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Research sub-question #3d. What is the relationship between students' frequency of original discussion forum posts and students' success?

Findings. Table 41 summarizes the findings when performing correlation and regression analysis for student success (DV) and frequency of discussion forum posts. Plotting the regression equation for frequency of discussion forum posts the Y value was student success (DV), and the X value was frequency of discussion forum posts (IV). The y-intercept was $\alpha = 67.176$. The regression coefficient (or slope of the line) was $\beta = 0.745$. Therefore, the regression equation was expressed as $Y = 67.176 + 0.745X$. The correlation coefficient *r* for the relation

between frequency of discussion forum posts and student success was $r(36) = 0.501$ ($p = 0.001$). The relationship between frequency of discussion forum posts and student success was a modest or moderate positive relationship. An increase in frequency of discussion forum posts (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.251$; therefore, 25.1% of the variation in student success (DV) can be accounted for by the variation in frequency of discussion forum posts (IV). The ratio of the variance that determines whether two variances—student success and frequency of discussion forum posts—are equal was F-ratio = 12.050 ($p = 0.001$). Since the F-ratio was greater than the F distribution critical value at $p = 0.01$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 32

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Original Discussion Forum Posts (IV) and Student Success (DV)

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Forum Posts	0.001***	67.176	0.745	0.501	0.251	12.050***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Research sub-question #3e. What is the relationship between students' frequency of discussion forum replies and students' success?

Findings. Table 42 summarizes the findings when performing correlation and regression analysis for student success (DV) and frequency of discussion forum replies. Plotting the regression equation for frequency of discussion forum replies the Y value was student success (DV), and the X value was frequency of discussion forum replies (IV). The y-intercept was $\alpha = 65.079$. The regression coefficient (or slope of the line) was $\beta = 0.584$. Therefore, the regression

equation was expressed as Y = 65.079 + 0.584X. The correlation coefficient *r* for the relation between frequency of discussion forum replies and student success was $r(36) = 0.574$ ($p = 0.000$). The relationship between frequency of discussion forum replies and student success was a modest or moderate positive relationship. An increase in frequency of discussion forum replies (IV) had a modest or moderate association with an increase in student success (DV). The coefficient of determination R^2 for the proportion of variance of one variable predicted from the other variable was $R^2 = 0.329$; therefore, 32.9% of the variation in student success (DV) can be accounted for by the variation in frequency of discussion forum replies (IV). The ratio of the variance that determines whether two variances—student success and frequency of discussion forum replies—are equal was F-ratio = 17.650 ($p = 0.000$). Since the F-ratio was greater than the F distribution critical value at $p = 0.01$, then the F-ratio was significant and indicated an overall goodness of fit of the regression equation.

Table 33

Regression Analysis to Determine Whether Relationships Exist Between Frequency of Original Discussion Forum Posts (IV) and Student Success (DV)

Criterion (DV)	Predictor (IV)	*p*-value	α	β	*r*	R^2	F
Student Success	Forum Replies	0.000***	65.079	0.584	0.574	0.329	17.650***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Summary of Findings

Table 34 summarizes the correlation and regression analyses for students' perceived level of engagement and students' actual level of engagement. Relationships that have a minimal level of significance with $\alpha = 0.10$ and correlation coefficients *r* less than +/-0.35 were found to occur between:

- Students' perceived level of total engagement and frequency of logins; $r(36) = 0.278$ ($p = 0.091$).
- Students' perceived level of performance engagement and frequency of logins; $r(36) = 0.296$ ($p = 0.072$).
- Students' perceived level of total engagement and frequency of discussion forum home views; $r(36) = 0.294$ ($p = 0.073$).
- Students' perceived level of skills engagement and frequency of discussion forum posts; $r(36) = 0.304$ ($p = 0.063$).
- Students' perceived level of performance engagement and frequency of discussion forum posts; $r(36) = 0.286$ ($p = 0.082$).
- Students' perceived level of emotional engagement and frequency of discussion forum replies; $r(36) = 0.318$ ($p = 0.052$).

Table 34

Linear Regression Using Correlation Coefficients (r): Effect of Students' Actual Levels of Engagement: Frequency of Initial Logins, Frequency of Page Visits, Frequency of Discussion Forum Views, Posts, and Replies; and Students' Perceived Level of Engagement: Total Engagement and its Four Subcategories (Skills, Emotional, Participation, And Performance)

		Skills Engagement (r)	Emotional Engagement (r)	Participation Engagement (r)	Performance Engagement (r)	Total Engagement (r)
Actual Levels of Engagement	Freq. of Logins	0.325**	0.192	0.185	0.296*	0.278*
	Freq. of Page Visits/Login	0.067	0.067	0.109	0.123	0.069
	Freq. of Resource Views	0.017	0.052	0.158	0.170	0.062
	Freq. of User Views	0.065	0.097	0.104	0.105	0.014
	Freq. of Quiz Views	0.048	0.039	0.197	0.245	0.140
	Freq. of Quiz Review Views	0.200	0.051	0.032	0.237	0.063
	Freq. of Forum Home Views	0.320**	0.191	0.247	0.206	0.294*
	Freq. of Forum Views	0.269	0.166	0.180	0.204	0.240
	Freq. of Forum Posts	0.304*	0.260	0.360**	0.286*	0.367**
	Freq. of Forum Replies	0.364**	0.318*	0.423***	0.210	0.425***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Relationships that had a level of significance with $\alpha = 0.05$ and correlation coefficients r less than +/-0.35 were found to occur between:

- Students' perceived level of skills engagement and frequency of logins $r(36) = 0.325$ ($p = 0.046$).

- Students' perceived level of skills engagement and frequency of discussion forum home views; $r(36) = 0.320$ ($p = 0.050$).

Relationships that had a level of significance with $\alpha = 0.05$ and correlation coefficients r ranging from +/-0.36-0.67 were found to occur between:

- Students' perceived level of total engagement and frequency of discussion forum posts; $r(36) = 0.367$ ($p = 0.023$).
- Students' perceived level of skills engagement and frequency of discussion forum replies; $r(36) = 0.364$ ($p = 0.025$).

Relationships that had a level of significance with $\alpha = 0.01$ and correlation coefficients r ranging from +/-0.36-0.67 were found to occur between:

- Students' perceived level of total engagement and frequency of discussion forum replies; $r(36) = 0.425$ ($p = 0.008$).
- Students' perceived level of participation engagement and frequency of discussion forum replies; $r(36) = 0.423$ ($p = 0.008$).

Table 35 summarizes correlation and regression analyses for student success using students final percentage marks with students' perceived level of engagement and students' actual level of engagement and student success. Relationships that had a minimal level of significance with $\alpha = 0.10$ and correlation coefficients r less than +/-0.35 were found to occur between:

- Students' frequency of quiz views and student success; $r(36) = 0.302$ ($p = 0.065$).

Table 35

Linear Regression Using Correlation Coefficients (r): Effect of Student Success Scores and Students' Perceived Level of Engagement: Total Engagement and its Four Subcategories (Skills, Emotional, Participation, and Performance); and Students' Actual Levels of Engagement: Frequency of Initial Logins, Frequency of Page Visits, Frequency of Discussion Forum Views, Posts, and Replies

		Student Success
Perceived Levels of Engagement	Skills Engagement	0.341**
	Emotional Engagement	0.232
	Participation Engagement	0.356**
	Performance Engagement	0.359**
	Total Engagement	0.377**
Actual Levels of Engagement	Freq. of Logins	0.256
	Freq. of Page Visits/Login	0.109
	Freq. of Resource Views	0.096
	Freq. of User Views	0.108
	Freq. of Quiz Views	0.302*
	Freq. of Quiz Review Views	0.371**
	Freq. of Forum Home Views	0.383**
	Freq. of Forum Views	0.393**
	Freq. of Forum Posts	0.501***
	Freq. of Forum Replies	0.574***

Note. * significant at $\alpha \leq 0.10$, $p < 0.10$; ** significant at $\alpha \leq 0.05$, $p < 0.05$, *** significant at $\alpha \leq 0.01$, $p < 0.01$.

Relationships that had a level of significance with $\alpha = 0.05$ and correlation coefficients r less than +/-0.35 were found to occur between:

- Students' perceived level of skills engagement and student success; $r(36) = 0.341$ ($p = 0.036$).
- Students' perceived level of participation engagement and student success; $r(36) = 0.356$ ($p = 0.028$).
- Students' perceived level of performance engagement and student success; $r(36) = 0.359$ ($p = 0.027$).

Relationships that had a level of significance with $\alpha = 0.05$ and correlation coefficients r ranging from +/-0.36-0.67 were found to occur between:

- Students' perceived level of total engagement and student success; $r(36) = 0.377$ ($p = 0.019$).
- Students' frequency of quiz review views and student success; $r(36) = 0.371$ ($p = 0.024$).
- Students' frequency of discussion forum home views and student success; $r(36) = 0.383$ ($p = 0.018$).
- Students' frequency of discussion forum views and student success; $r(36) = 0.393$ ($p = 0.015$).

Relationships that had a level of significance with $\alpha = 0.01$ and correlation coefficients r ranging from +/-0.36-0.67 were found to occur between:

- Students' frequency of discussion forum posts and student success; $r(36) = 0.501$ ($p = 0.001$).
- Students' frequency of discussion forum replies and student success; $r(36) = 0.574$ ($p = 0.000$).

Chapter Summary

The academic community has long understood the importance of student engagement and its relationship to student success. In this study, student engagement was measured by students' perceived level of engagement and students' actual level of engagement as measured by an LMS of an online course. This study employed correlation and regression analyses to determine whether relationships existed between students' perceived level of engagement and students'

actual level of engagement, students' perceived level of engagement and student success, and students' actual level of engagement and student success.

Findings suggest low or weak positive relationships between students' perceived level of engagement and frequency of logins and discussion forum views, as well as between students' perceived level of engagement and student success. For example, the correlation coefficient *r* for the relationship between students' perceived level of engagement in total engagement ($r(36) = 0.278$; $p = 0.091$) and frequency of logins, skills engagement ($r(36) = 0.325$, $p = 0.046$) and frequency of logins, as well as between performance engagement ($r(36) = 0.296$, $p = 0.072$) and frequency of logins showed low or weak positive relationships. The correlation coefficient *r* for the relationship between students' perceived level of engagement in total engagement ($r(36) = 0.294$, $p = 0.073$) and frequency of discussion forum views; skills engagement ($r(36) = 0.304$, $p = 0.063$) and frequency of discussion forum posts; performance engagement ($r(36) = 0.286$, $p = 0.082$) and frequency of discussion forum posts; and emotional engagement ($r(36) = 0.318$, $p = 0.052$) and frequency of discussion forum replies showed low or weak positive relationships. Additionally, correlation coefficients *r* between students' perceived level of skills engagement ($r(36) = 0.341$, $p = 0.036$), students' perceived level of participation engagement ($r(36) = 0.3656$, $p = 0.028$), students' perceived level of performance engagement ($r(36) = 0.359$, $p = 0.027$) and their relationship to student success showed low or weak positive relationships.

Findings that suggest modest or moderate positive relationships were generally associated with students' perceived level of engagement and discussion forum posts and replies; students' perceived level of engagement and student success; and students' actual level of engagement with respect to quiz review views, discussion forum views, posts, and replies and student success. For example, correlation coefficients *r* for the relationships between students' perceived

level of total engagement ($r(36) = 0.367$, $p = 0.023$) and discussion forum posts; and students' perceived level of total engagement ($r(36) = 0.425$, $p = 0.008$), students' perceived level of skills engagement ($r(36) = 0.364$, $p = 0.025$), students' perceived level of participation engagement ($r(36) = 0.423$, $p = 0.008$) and discussion forum replies indicated a modest or moderate positive relationship. Correlation coefficients r for the relationships between students' perceived level of total engagement ($r(36) = 0.377$, $p = 0.019$) and student success showed a modest or moderate positive relationship. Additionally, correlation coefficients r for students' actual level of engagement with respect to frequency of quiz views ($r(36) = 0.371$, $p = 0.024$), frequency of discussion forum views ($r(36) = 0.383$, $p = 0.018$), frequency of discussion forum views ($r(36) = 0.393$, $p = 0.015$, frequency of discussion forum posts ($r(36) = 0.501$, $p = 0.001$), frequency of discussion forum replies ($r(36) = 0.574$, $p = 0.000$) and its relation to student success showed a modest or moderate positive relationship.

The following chapter reviews the purpose of the study, as well as its design and rationale. Results are summarized to answer the study's three guiding research questions, significant findings are presented, interpretations are made, limitations are discussed, and recommendations for future research are offered.

Chapter 5: Findings, Discussion, Implications and Recommendations

Introduction

Academia has long understood the importance of student engagement and its relationship to positive student outcomes, such as higher order thinking, improved grades, and increased retention and graduation rates. LMSs have the ability to measure students' actual levels of engagement by tracking their online behavior and documenting student success levels. Just as important as students' actual level of engagement, students' perceived level of engagement produce positive outcomes as well. Students who are aware of their level of engagement compared to those levels measured by an LMS can self-monitor their progress and avoid failing a course. Consequently, the purpose of this initial exploratory study was to determine whether relationships existed between students' perceived level of engagement and students' actual level of engagement, students' perceived level of engagement and student success, and students' actual level of engagement and student success.

Correlation and regression analyses were performed to answer the study's research questions:

1. What is the relationship between students' perceived level of engagement and students' actual level of engagement as measured by an LMS?
2. What is the relationship between students' perceived level of engagement and student success?
3. What is the relationship between students' actual level of engagement as measured by an LMS and student success?

Three numeric variables were inputted into the SPSS statistical software: students' actual level engagement, students' perceived level of engagement, and student success. Students' actual

level of engagement produced a numeric value by calculating students' frequency of logins, frequency of page visits, and frequency of discussion forum views, posts, and replies. Students' perceived level of engagement produced a numeric value by completing Marcia Dixson's (2010) OSES. The Likert-style questionnaire consisted of 19 items, which required students to self-assess their engagement levels by rating statements pertaining to engagement on a scale of 0 (not at all characteristic of me) to 4 (very characteristic of me), producing a total engagement score ranging from 0 to 76. The total engagement score is broken down into four subcategories: skills engagement, emotional engagement, participation engagement, and performance engagement—each producing another set of numeric values. Student success was measured by calculating students' final percentage mark. Final percentage marks were determined by dividing total points earned by total points possible and multiplying that quotient to 100. The variables were used to answer the study's three guiding research questions.

The sample population for this initial exploratory study consisted of 38 students who enrolled in either an online Natural Disasters course or in an online Race and Culture in the Americas course. This study used a non-probability, purposive sampling technique. The setting for the study took place within CSULA's LMS (Moodle). The Natural Disasters course and the Race and Culture in the Americas course were offered to undergraduate students in the spring 2013 quarter.

Review of Findings

After collection and analyses of data, the demographic profile of the sample was found to be made up of mostly female students (76.3%, $N = 29$), whose ages ranged from 18-24 years old (92.1%, $N = 25$), and identified themselves mainly as Latin/Chicano/Hispanic (74.0%, $N = 28$). The majority of the students reported part-time enrollment status, with 65% ($N = 25$) enrolling in

9-12 units. Most participants had estimated GPAs in the 2.5-2.9 range (39.5%, *N* = 15), and had aspirations of completing a bachelor's degree (31.6%, *N* = 12) or a master's degree (52.6%, *N* = 20). Almost half (45.0%, *N* = 17) of the sample said that this course was their first online course. In addition, most of the students stated they work part-time outside the home with 26.3% (*N* = 10) working 1-10 hours per week, 23.7% (*N* = 9) working 11-20 hours per week, and 10.5% (*N* = 4) working 21-20 hours per week. Several issues may explain the demographic profile of the sample. It can be assumed that students who are more engaged were more likely to complete the survey and take part in the study. Research has shown that students who are more engaged have high aspirations to succeed (Astin, 1984; Chickering & Gamson, 1987; Tinto, 2005). Approximately 85% of the students polled stated they have set their highest educational goal as a bachelor's degree or a master's degree. Although research has also shown that full-time students are more engaged than part-time students (Kuh, 2003), this study yielded conflicting findings, with the majority of the students enrolling as part-time students. This finding may be due to the residual effects of the 2008-2012 economic crisis where not enough courses were being offered for the number of students enrolled (Rivera & Gordon, 2012), forcing many students to enroll part time rather than the desired full-time status. Lastly, according to College Portraits (2013), the average student age at CSULA is 23, which corresponds the majority of students sampled being in the 18-24 age range.

Research question #1 explored whether relationships existed between students' perceived level of engagement and students' actual level of engagement as measured by an LMS. The findings suggest low or weak but statistically significant positive partial relationships between students' perceived level of engagement (total engagement, skills engagement, and performance engagement) and frequency of logins, students' perceived level of engagement (total engagement

and skills engagement) and frequency of discussion forum home views, students' perceived level of engagement (skills engagement and performance engagement) and frequency of discussion forum posts, and students' perceived level of engagement (emotional engagement) and frequency of discussion forum replies. Modest or moderate positive partial relationships were found between students' perceived level of total engagement and frequency of discussion forum posts, and perceived level of engagement (total engagement, skills engagement, and participation engagement) and frequency of discussion forum replies.

Research question #2 explored whether relationships existed between students' perceived level of engagement and student success. Findings suggest low or weak but statistically significant positive partial relationships in students' perceived level of engagement (skills engagement, performance engagement, and performance engagement) and student success. There was also a modest or moderate positive relationships in students' perceived level of total engagement and student success.

Research question #3 explored whether relationships existed between students' actual level of engagement and student success. Although there was a low or weak but statistically significant positive relationship in students' actual level of engagement in frequency of quiz views and student success, the majority of the findings showed modest or moderate positive relationships between students' actual level of engagement (frequency of quiz review views, frequency of discussion forum home page views, frequency of discussion forum views, frequency of discussion forum posts, and frequency of discussion forum replies) and student success.

Discussion

After a thorough review of the results, two major findings and one minor finding were unearthed and worth mentioning. The first major finding dealt with unexpected results with regard to relationships between students' perceived level of engagement, students' actual level of engagement as measured by frequency of logins, and student success. Research has shown that positive relationships exist between students' perceived level of engagement and frequency of logins, and between students' frequency of logins and student success (Beer et al., 2010). In other words, the more times a student logs in to an LMS, the more engaged a student perceives himself or herself to be (Morris et al., 2005). Moreover, the more times a student logs in, the more likely he or she succeeds in a course (Carini, 2006; Junco, 2012; Kuh et al., 2008). As expected, this study found a low or weak positive relationship between students' perceived level of engagement and students' frequency of logins. In other words, students who log on more frequently perceive themselves to be more engaged. However, there was no relationship between students' perceived level of engagement and student success. Students who logged on more frequently did not necessarily achieve student success.

The second major finding also dealt with unexpected results with regard to relationships between students' perceived level of engagement and students' actual level of engagement as measured by the number of times a student studied for an exam (frequency of quiz review views), and between the number of times a student studied for an exam and student success. Morris et al. (2005) asserted that successful students spent more time studying and reviewing lecture notes and quizzes than unsuccessful students. Mogus, Djurdjevic, and Suvak (2012), and Fritz (2011) also explored students' online activity and its relationship to student success, and found a strong positive correlation between students' activity logs and students' final marks.

Furthermore, Beer et al. (2010) add that a positive relationship exists between student participation as measured by frequency of page visits and student engagement. More engaged students log in and visit more pages than less engaged students. Interestingly, this study did support previous studies and found that students who studied for quizzes more—had a higher frequency of quiz review views—had higher rates of student success. Unexpectedly, there were no relationships between students' frequency of quiz review views and students' perceived level of engagement. Students who reviewed past quizzes did not have higher levels of perceived engagement. Yet, data shows that these online behaviors are correlative to student success.

The minor finding deals with expected results worth mentioning because it supports previous studies and provides value for future studies. The strongest relationships that exist between students' perceived level of engagement, students' actual level of engagement, and student success occurred in the discussion forums. Students who had high frequencies of discussion forum posts and replies had higher perceived levels of engagement. In addition, students who had higher frequencies of discussion forum posts and replies had higher rates of student success. This is not surprising since Hu and Kuh (2002) assert that student engagement is a function of student interactions. Dawson et al. (2009) argue that more than 80% of student interactions occur in the discussion forums of an LMS. Dixson (2010) claims that highly engaged students are more likely to use discussion forums to interact with other students and the instructor than less engaged students. Furthermore, Beer et al. (2010) add that discussion forums have the ability to promote student interaction and engagement, thus increasing the likelihood of student success.

Implications

The above findings suggest that educators need to do more than just deliver course

content. This is supported by results showing that students who log on more frequently are not achieving student success. Students who are successful are students who have a higher frequency of posts and replies to discussion forums. Dawson et al. (2009) found a strong correlation between student achievement and participation in discussion forums. Therefore, educators need to encourage students to interact and engage with the course material, other students, and the instructor (Ebner, 2007).

Increasing student interaction and engagement may be achieved by making discussion forum participation a course requirement; giving clear instructions and guidelines to the quantity of posts and replies, the length of posts and replies, and content of posts and replies; stating due dates; providing interesting prompts; starting small and simple to encourage participation and increasing in complexity when posting and replying become more natural; and demonstrating proper online behavior. Bliss and Lawrence (2009) emphasize the importance of prompt feedback and instructor presence to increase student participation. Another tactic to increase student participation is to present higher-order thinking questions. Ertmer, et al., (2011) examined types of questions that elicited critical thinking, and found that higher-order thinking questions produced higher frequencies of student interaction.

Instructors can incorporate teaching techniques to ensure students are viewing previous posts and replies found within discussion forums. For example, instructors could create exam questions that directly tie into discussion forum topics, or create prompts that require students to read previous posts and or replies in order to participate. Practices that promote student interaction and engagement could be initiated at the administration level.

Administrators could also help increase online student success by offering professional development opportunities for faculty, and hiring a team of online developers—learning

technologists, instructional designers, and computer programmers—to improve online teaching practices. Professional development can help educators realize other ways to increase student interaction and engagement within LMSs. Many studies have shown that interactive components of an LMS increase student interaction and engagement (Saade, et al., 2012; Ebner, 2007). There are a variety of interactive components within LMSs that can promote interaction, collaboration, networking, and sharing. For example, announcements and messages push important information to student emails to ensure delivery, instant chat and web conferencing allow for synchronous communication, online quizzes and surveys provide immediate feedback on student progress, and reports and tracking student activity levels provide valuable insights to students' real-time performance (Moodle™, 2013, Blackboard™, 2013). Third party tools, such as videos, study aides, and games, can also be incorporated into LMSs to augment student interaction and engagement.

A team of online developers—learning technologists, instructional designers, and computer programmers—can also help to improve the quality of online teaching and learning. The quality of student engagement has a direct effect on student success (Cross & Angelo, 1988; Fehrmann et al., 1987). Learning technologists could help incorporate emerging technologies, pedagogy, and best practices in online environments; instructional designers could assist with the learning experience by creating an appealing and efficient layout; and computer programmers could write code to develop programs, such as online dashboards, to assist with tracking student's online activity. The online dashboard can generate and show students' activity logs. Students, and educators, could have real-time access to the frequency of logins, frequency of quiz review views, and frequency of discussion forum posts, views and replies. In addition,

students could access class averages, ranges, and how they compare to the rest of the class. Dashboards have the potential to help students and educators track student progress in real time.

Research has shown that students who self-regulate and self-evaluate learning have higher rates of achievement (Zimmerman & Pons, 1986). LMSs can be designed to provide the necessary information for students to become aware of their own learning strategies. Students can easily access and monitor their LMS usage, and compare their online behavior relative to others in the course. Self-monitoring and self-regulating provide valuable insights to students' learning and enhance their perceived level of engagement. Online dashboards, programmed to extract and display pertinent data, could help students, and educators, identify at-risk behaviors early (Siemens, 2012). Identifying at-risk behaviors early in the course, rather than after the course has ended, could mitigate the potential of students failing a course.

Limitations of the Study

Limitations of the study were confined to subjective aspects of the research. For example, the first limitation existed in results of students' self-report of their perceived level of engagement. Students at different levels of their academic career and in different learning environments may have different learning experiences, which may influence factors on their perceptions. In addition, students who are more engaged are more likely to read their emails and complete a survey than students who are less engaged.

Another limitation of this study was using students' final percentage scores as a measure of student success. Typically, student success is measured by students' final grade in a course, which is based on their final percentage score. Although Angelo and Cross (1993) and Cross and Angelo (1988) argue that grades are a form of summative assessment that inform educators about

students' performance level, Picciano (2002) counters that grades can be problematic due to grade inflation and to variations in instructor standards and rigor.

Recommendations for Future Research

To address the disparity of using students' final percentage scores as an indicator for student success, future studies should include qualitative methods, such as content analysis of the discussion forums, to determine students' understanding, reasoning, and development of critical thinking and problem solving skills in a course (Hara, Bonk, & Angeli, 1998). Content analysis would employ identifiers or indicators within discussion forums to measure levels of critical thinking. Newman, Web, and Cochrane (2004) developed a list of paired indicators of critical and uncritical thinking. For example, when coding for *relevance*, the researchers produced two indicators: relevant statements and irrelevant statements. The statements may be phrases, sentences, or paragraphs. To alleviate the arduous task of coding vast amounts of text found in discussion forums, the researchers chose to not classify every statement. Only obvious examples were coded and the less obvious ones were ignored. Newman et al. claim that this method is useful in measuring levels of critical thinking and may be used in various learning settings where transcripts are recorded.

In addition, although the sample size was small, it did limit the generalizability of the study. Future studies should include a larger sample, which would allow the researcher to maximize the chance of uncovering statistical significance between the variables and establish a confidence interval true to the percentage. This may be achieved by allowing students to take Marcia Dixson's (2010) OSES at the beginning of the quarter when they are more engaged and more likely to complete the survey rather than at the end of the quarter when only students who persist and are more likely to succeed are available to partake in the survey. Moreover, recruiting

from a larger sample that is representative of all online students who attend a large, public university, such as all students enrolled in at least one online course within the entire CSU system, would determine whether findings are statistically significant or not.

Lastly, the study produced low R^2 coefficient of determination, which is expected when exploring relationships of single variables. This study determined relationships between individual variables—such as students' perceived level of engagement, students' actual level of engagement, and student success—and ran correlations between single variables. Future research should include performing multiple regression analysis by adding demographic variables to the one-predictor variable. Adding demographic variables that have been linked to student engagement to the already-studied variables in this study may increase the R^2 coefficient of determination. For example, students' educational goals have been found to be a significant predictor of student success (Astin, 1984; Chickering & Gamson, 1987; Tinto, 2005). Adding students' educational goals to frequency of discussion forum posts may increase the R^2 coefficient of determination when determining relationships between students' actual level of engagement in discussion forums and student success, thus yielding higher statistical significance.

Conclusion

Student engagement has been linked to a variety of positive student outcomes, such as higher-order thinking, improved grades, and increased retention and graduation rates. Coates et al. (2005) and Floyd et al. (2009) assert that high levels of student engagement result in the development of higher-order thinking skills. Students who process and evaluate concepts at higher thinking capacities typically earn higher grades. Carini et al. (2006) found positive relationships in student engagement and students' GPAs. The more a student is engaged, the

higher his/her GPA. Higher GPAs ultimately lead to student persistence and college completion (Klem & Connell, 2004; Kuh et al., 2006; Tinto, 1997).

Online learning has seen a steady rise in student enrollments in recent decades (Allen & Seaman, 2010). However, the increase rise in online student enrollment has not resulted in an increase in student success (Brock, 2010). As a matter of fact, the NCHEMS (2009) provides data for the 10 largest online institutions, citing retention and graduate rates to be the lowest in the nation at 55% and 28%, respectively. As previously stated, student engagement has been linked to various positive student outcomes including student success as measured by persistence and graduation rates. However, a gap in the literature shows a scarcity of studies measuring student engagement in an online course. This initial exploratory study employed learning analytics—a method of extracting and analyzing data to inform administrators and educators of student learning—to measure student engagement in an online course. This study examined ways to measure both students' perceived level of engagement and students' actual level of engagement as measured by an LMS. Students' perceived level of engagement was quantified by using Marcia Dixson's (2010) OSES, which asks students to self-assess their level of engagement on a 19-item, Likert-style questionnaire. Students' actual levels of engagement were determined by extracting data from an LMS. Students' frequency of logins, frequency of page visits, and frequency of discussion forum views, posts, and replies were measured.

Initial findings from this study support the literature in that students who reported higher levels of perceived engagement had higher frequency of logins. Surprisingly, students who had higher frequency of logins did not experience higher rates of success. Furthermore, students who displayed higher levels of actual engagement by studying more—had higher frequencies of quiz review views—experienced higher rates of success. Unexpectedly, students who studied more—

had higher frequency of quiz review views—did not report higher levels of perceived engagement. These findings suggest that students need to do more than just log on to be successful in an online course. Rather, students should interact and engage in the discussion forums. In addition, students need to realize that studying for quizzes or exams is an important behavior for online success. Students, and educators alike, need training on LMS usage and ways to increase interaction and engagement. A dashboard that displays students' activity levels may be helpful for all stakeholders. If so, students and educators ccould modify their learning or teaching behaviors to increase the likelihood of student success.

This initial exploratory study is useful in helping to refine future studies, especially in recruiting a larger population, adding known demographic variables related to engagement to the single-predictor variables used for this study, and performing content analysis to assess higher-order thinking. The methods and results of this study may be used or refined to help higher education institutions learn more about their students' engagement levels. Results can potentially help administrators make data-based decisions when implementing new or modifying existing online policies; redesigning traditional, hybrid, flipped, or online courses; or hiring effective teams (i.e. content experts, education and learning technologists, and computer programmers) to enhance students' learning experiences. Results may also inform educators by providing real-time data about students' current progress. Educators will be able to modify existing teaching practices to prevent the likelihood of student failure. Lastly, students will be able to self-monitor and self-assess their own progress. By comparing their levels of engagement to those levels of engagement of successful peers, students will be able to adjust their learning or studying habits to increase their chances of success.

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APPENDIX A

Informational Cover Letter

To Project Participant:

You are invited to take part in a research project conducted by Angelique C. Hamane, Lecturer from California State University, Los Angeles. In this study we hope to learn more about the relationships between students' level of engagement and student success in an online course. You were selected to participate in this study because you are registered for a completely online course at CSULA. We hope that our research will lead to improved online student success in higher education.

Should you choose to participate in this study, you will be asked to complete a two-part questionnaire. The first part of the survey consists of a 10-item demographic section where respondents answer questions to age, gender, race/ethnicity, etc. The second part of the survey consists of a 19-item Online Student Engagement Survey developed and validated by Marcia Dixson. Respondents are asked to rank statements from 0 (not at all characteristic of me) to 4 (very characteristic of me). The entire survey should take approximately 15 minutes to complete. Survey results will be correlated to existing Learning Management System data, such as frequency of logins, page visits, and discussion forum views, posts and replies, and your final percentage to measure achievement of course objectives.

Your participation in the study is voluntary. Refusal to participate will not affect your class standing, grades, or relationship with the instructor. Once you complete the survey, you will be entered into a random drawing for a chance to win a $50 Amazon gift card by filling in your name and email address on a separate form. The drawing will occur on Wed., July 3, 2013. Participants will have a 1 in 30 chance of winning and will be notified by email on Friday, July 5, 2013. Subjects may choose to withdraw from the study any time without withdrawing from the raffle.

This study poses minimal risk and discomforts to the participant. All information gathered in this study will remain confidential and given out only with your permission or as required by law. If you give us permission, we will protect your confidentiality. A research assistant will be used to collect and correlate survey responses, existing LMS data, and students' final percentage marks. Student names are necessary initially to correlate students' data. Once correlation of data is complete, the research assistant will assign generic codes in lieu of student names so that data cannot be directly or indirectly linked to students. Once data are coded, the research assistant will deliver the password-protected excel sheet to the researcher and destroy all files that contain students' identities immediately afterwards. All records will be stored in a password-protected file on the researcher's and the research assistant's personal computer for a minimum of 3 years following completion of the study. Afterwards, all records will be destroyed. Data may be used for similar future research, publications, and presentations. Should disclosure of data regarding this study occur, participants will not be at risk of criminal or civil liability or damage of financial standing, employability, or reputation. No deception is used in this study.

If you have any questions about this research at any time, please call Angelique C. Hamane, Principal Investigator, at (626) 482-4288 or write her at ahamane2@calstatela.edu, Dr. Pedro Ramirez, research assistant, at pramire@calstatela.edu, or Andrea Shea, research assistant, at Andrea.shea@pepperdine.edu.

Should you agree to voluntarily participate in the study, please click on the following link: [link to survey]. By clicking the link and completing the survey, you are also giving the researcher and assistant permission to extract LMS data and achievement scores. If you agree to take part, you are free to withdraw from the study at any time. Likewise, no penalty or loss of benefits to which you are otherwise entitled will occur.

Sincerely,

Andrea Shea, Research Assistant

THIS PROJECT HAS BEEN REVIEWED BY THE CALIFORNIA STATE UNIVERSITY, LOS ANGELES INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS IN RESEARCH. ADDITIONAL CONCERNS AND COMPLAINTS, OR QUESTIONS REGARDING YOUR RIGHTS AS A RESEARCH PARTICIPANT, SHOULD BE DIRECTED TO THE DEAN OF GRADUATE STUDIES AND RESEARCH (Phone number: 323-343-3798).

APPENDIX B

CSULA IRB Approval

Office Memorandum

DATE: May 23, 2013

TO: Angelique Hamane, Pedro Ramirez and Andrea Shea
Geoscience and Environment

FROM: Elia Amaro, Institutional Review Board – Human Subjects

COPIES TO: S. Ulanoff, IRB Chair; J. Shiotsugu, Executive Secretary; M. Costa, Member

SUBJECT: Review of Project Involving Human Subjects

Applicant: Angelique Hamane, Pedro Ramirez and Andrea Shea

Title: Student Engagement in an Online Course and its Impact on Student Success

Application #: 12-104

Date of Review: 05/22/2013

Action:
__X__ Approved (valid for one year)
_____ Convened committee
__X__ Expedited (reviewed and approved by IRB chair or designee)
_____ Pending modification to secure approval (see below)
_____ Denied - see below
_____ Tabled - see below
__X__ Administrative Action-Expedited Category # 5 and 7

Approval Period: 05/23/13 – 05/22/14

YOU MAY NOT CONTINUE BEYOND THE APPROVAL PERIOD WITHOUT SUBMITTING A CONTINUATION APPLICATION ONE MONTH BEFORE EXPIRATION DATE.

Office of Research and Development

APPENDIX C

Cooperative IRB Agreement Between CSULA and Pepperdine

Appendix A Cooperative Agreement between Two IRBs

Institutional Review Board Cooperative Agreement

In order to avoid duplication of effort and minimize time delays in the Institutional Review Board (IRB) review process, **California State University, Los Angeles (CSULA)** and **Pepperdine University** enter into this Cooperative Agreement. The officials having signed below commit their respective IRBs to the following binding agreement with regard to reliance upon each others' Institutional Review Boards for review of the **CSULA's**] IRB Protocol # **12-104** entitled "**Student Engagement in an Online Course and its Impact on Student Success.**"

The **CSULA** and the **Pepperdine University** hereby give assurance that each IRB will comply with the principles and procedures for protecting human research subjects specified below as well as those required by law. The officials in this document have designated, in writing, that the **CSULA** will conduct the IRB review as the Primary IRB. This designation must be reported to each of the IRBs at their next meeting. The Primary Board will conduct the initial IRB review and continuing reviews utilizing their established policies and procedures. The Secondary Board will not conduct a formal review(s) of the protocol but will rely on the review(s) by the Primary Board. The Secondary Board is also responsible for the research conducted by the **Pepperdine University** investigator on this Protocol **Angelique Hamane**.

The participating institutions agree to comply with the following principles regarding research involving human subjects:

A. **CSULA** and **Pepperdine University** are guided by the ethical principles regarding research involving human subjects as set forth in the CFR 45, Part 46 and the Belmont Report. These ethical principles shall guide these institutions in the conduct of their human subjects research.

B. In conducting a review as the Primary IRB institution, it will:

(1) recognize that all human subjects research must be conducted in accordance with the United States Federal Policy for the Protection of Human Research Subjects.
(2) be responsible for the initial and continuing review of the project in accordance with the requirements of 45 CFR 46.
(3) report promptly to the other party to this agreement and to any sponsoring agency:
(i) any unanticipated problems or injuries involving risks to subjects or others,
(ii) any serious or continuing noncompliance with the federal rules or with the requirements or determinations of the Primary IRB,
(iii) any changes in a project which are reviewed and approved by the Primary IRB, and
(iv) any suspension or termination of IRB approval by the Primary IRB.

C. The designated Primary IRB shall keep the Secondary IRB informed and, at a minimum, shall provide copies of the submitted protocol, any revisions to the protocol, copies of continuing reviews, and any minutes of meetings of the Primary IRB that include actions or discussions regarding the referred protocol.

D. IRB disapprovals of any protocol referred under this cooperative agreement may not be administratively overruled by either cooperating institution.

This cooperative agreement was agreed to on 06/05/13 by:

Lawrence Fritz, Ph.D.
Institutional Official, **CSULA**
On behalf of the IRB

Sharon Ulanoff, Ph.D.
Chairperson, **CSULA**
On behalf of the IRB

Doug Leigh, Ph.D.
Chairperson, **Pepperdine University**
On behalf of the IRB

APPENDIX D

Demographic Questions

1. How old are you?
    a. Less than 18 years old
    b. 18-24 years old
    c. 25-32 years old
    d. 33-40 years old
    e. greater than 40 years old

    (Fordtoft, 1987; Muilenburg & Berge, 2005)
2. Gender
    a. Male
    b. Female

    (Kuh, 2005b; Muilenburg & Berge, 2005)
3. Which ethnicity do you most closely identify yourself with?
    a. Asian/Pacific Islander
    b. Black
    c. Filipino
    d. Latino/Chicano/Hispanic
    e. Native American
    f. White

    (Kuh, 2005b; Muilenburg & Berge, 2005)
4. While enrolled in this online course, how many units were you taking?
    a. 4 units (this was my only class)
    b. 5-8 units
    c. 9-12 units
    d. 13-16 units
    e. 17 or more units

    (Kuh, 2005b)
5. While enrolled in this online course, what would you estimate your GPA to be?
    a. Less than 2.0
    b. 2.0-2.4
    c. 2.5-2.9
    d. 3.0-3.4
    e. 3.5-3.9
    f. 4.0

    (Carini, 2006, Kuh, 2005b; Muilenburg & Berge, 2005)
6. What is your highest educational goal?
    a. To complete some classes
    b. To complete an A.A. or A.S.
    c. To complete a B.A. or B.S.
    d. To complete a master's degree
    e. To complete a doctoral degree

    (Astin, 1985; Chickering & Gamson, 1987; Tinto, 2005)

7. Including this online course, what is the total number of online classes you've taken?
    a. One online class (this was my first online class)
    b. Two online classes
    c. Three online classes
    d. Four online classes
    e. Five or more online classes

    (Muilenburg & Berge, 2005)
8. While enrolled in this online course, approximately how many hours outside of the home did you work?
    a. 0 hours per week
    b. 1-10 hours per week
    c. 11-20 hours per week
    d. 21-30 hours per week
    e. 31-40 hours per week
    f. more than 40 hours per week

    (Muilenburg & Berge, 2005)

For the questions #s 9 and 10, check the box that mostly closely represents how much you agree or disagree with the statement.

9. I enjoy online learning.
    a. Strongly Disagree
    b. Disagree
    c. Neither disagree or agree
    d. Agree
    e. Strongly Agree

    (Muilenburg & Berge, 2005)
10. I have am confident of my abilities with online learning technology.
    a. Strongly Disagree
    b. Disagree
    c. Neither disagree or agree
    d. Agree
    e. Strongly Agree

    (Muilenburg & Berge, 2005)

APPENDIX E

Online Student Engagement Survey

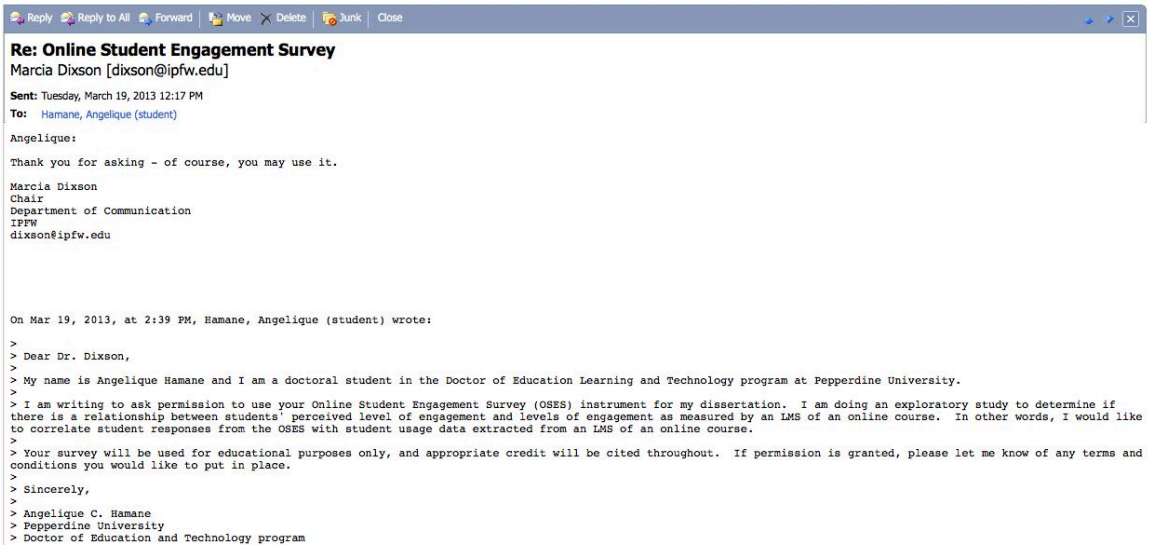
By Marcia Dixson

1. Making sure to study on a regular basis (Skills subscale)
2. Putting forth effort (Emotional subscale)
3. Staying up on the readings (Skills subscale)
4. Looking over class notes between getting online to make sure I understand the material (Skills subscale)
5. Being organized (Skills subscale)
6. Taking good notes over readings, PowerPoints, or video lectures (Skills subscale)
7. Listening/reading carefully (Skills subscale)
8. Finding ways to make the course material relevant to my life (Emotional subscale)
9. Applying course material to my life (Emotional subscale)
10. Finding ways to make the course interesting to me (Emotional subscale)
11. Really desiring to learn the material (Emotional subscale)
12. Having fun in online chats, discussions or via email with the instructor or other students (Participation subscale)
13. Participating actively in small-group discussion forums (Participation subscale)
14. Helping fellow students (Participation subscale)
15. Getting a good grade (Performance subscale)
16. Doing well on the tests/quizzes (Performance subscale)
17. Engaging in conversations online (chat, discussions, email) (Participation subscale)
18. Posting in the discussion forum regularly (Participation subscale)
19. Getting to know other students in the class (Participation Subscale)

* Student Responses range from 0 (Not at all characteristic of me) to 4 (very characteristic of me)
** Highly engaged students are those who reported engagement scores above the mean of 3.4 (Dixson, 2010).

APPENDIX F

Permission to Use OSES Instrument by Author Marcia Dixson



Reply | Reply to All | Forward | Move | Delete | Junk | Close

Re: Online Student Engagement Survey

Marcia Dixson [dixson@ipfw.edu]

Sent: Tuesday, March 19, 2013 12:17 PM

To: Hamane, Angelique (student)

Angelique:

Thank you for asking - of course, you may use it.

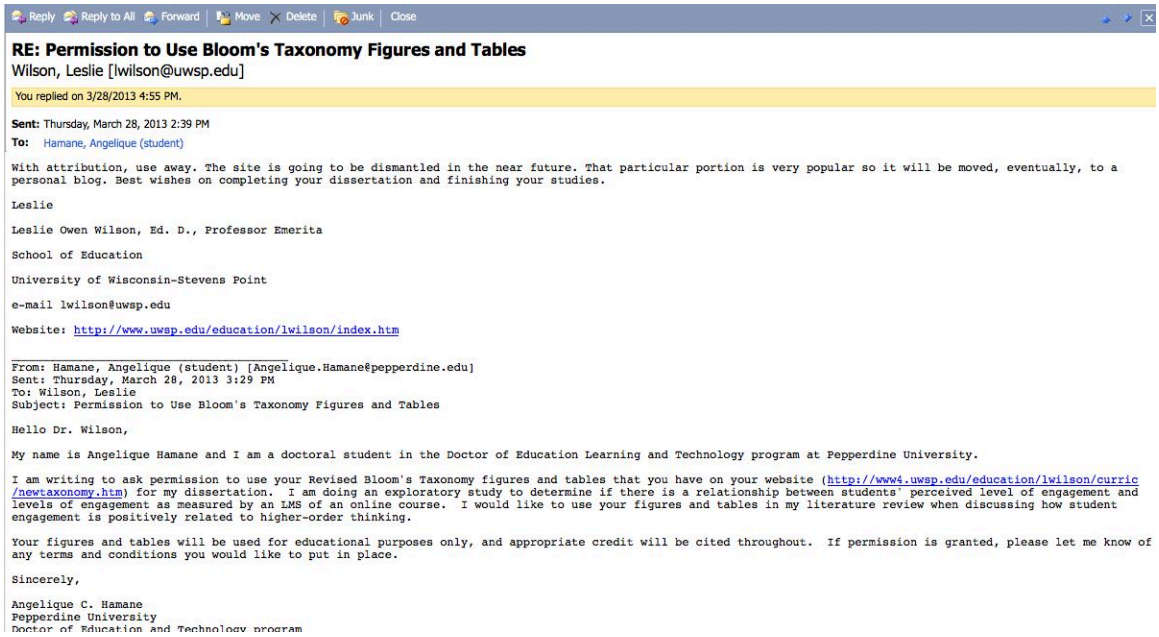
Marcia Dixson
Chair
Department of Communication
IPFW
dixson@ipfw.edu

On Mar 19, 2013, at 2:39 PM, Hamane, Angelique (student) wrote:

> Dear Dr. Dixson,
>
> My name is Angelique Hamane and I am a doctoral student in the Doctor of Education Learning and Technology program at Pepperdine University.
>
> I am writing to ask permission to use your Online Student Engagement Survey (OSES) instrument for my dissertation. I am doing an exploratory study to determine if there is a relationship between students' perceived level of engagement and levels of engagement as measured by an LMS of an online course. In other words, I would like to correlate student responses from the OSES with student usage data extracted from an LMS of an online course.
>
> Your survey will be used for educational purposes only, and appropriate credit will be cited throughout. If permission is granted, please let me know of any terms and conditions you would like to put in place.
>
> Sincerely,
>
> Angelique C. Hamane
> Pepperdine University
> Doctor of Education and Technology program

APPENDIX G

Permission to Use Bloom's Taxonomy Figure and Table



Reply | Reply to All | Forward | Move | Delete | Junk | Close

RE: Permission to Use Bloom's Taxonomy Figures and Tables

Wilson, Leslie [lwilson@uwsp.edu]

You replied on 3/28/2013 4:55 PM.

Sent: Thursday, March 28, 2013 2:39 PM

To: Hamane, Angelique (student)

With attribution, use away. The site is going to be dismantled in the near future. That particular portion is very popular so it will be moved, eventually, to a personal blog. Best wishes on completing your dissertation and finishing your studies.

Leslie

Leslie Owen Wilson, Ed. D., Professor Emerita

School of Education

University of Wisconsin-Stevens Point

e-mail lwilson@uwsp.edu

Website: http://www.uwsp.edu/education/lwilson/index.htm

From: Hamane, Angelique (student) [Angelique.Hamane@pepperdine.edu]
Sent: Thursday, March 28, 2013 3:29 PM
To: Wilson, Leslie
Subject: Permission to Use Bloom's Taxonomy Figures and Tables

Hello Dr. Wilson,

My name is Angelique Hamane and I am a doctoral student in the Doctor of Education Learning and Technology program at Pepperdine University.

I am writing to ask permission to use your Revised Bloom's Taxonomy figures and tables that you have on your website (http://www4.uwsp.edu/education/lwilson/curric/newtaxonomy.htm) for my dissertation. I am doing an exploratory study to determine if there is a relationship between students' perceived level of engagement and levels of engagement as measured by an LMS of an online course. I would like to use your figures and tables in my literature review when discussing how student engagement is positively related to higher-order thinking.

Your figures and tables will be used for educational purposes only, and appropriate credit will be cited throughout. If permission is granted, please let me know of any terms and conditions you would like to put in place.

Sincerely,

Angelique C. Hamane
Pepperdine University
Doctor of Education and Technology program